TAP

TECHNOLOGY ATTRACTION POLES

STANDARDISATION

TELECOMMUNICATIONS

SPACE SECTOR

CLEAN TECHNOLOGIES

NEW MATERIALS

.be

TAP
Technology Attraction Poles
Phases 1 and 2

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Context

For a long time the Belgian Science Policy has been committed to a series of research programmes designed to support and strengthen Belgium's scientific capability in high technology areas that are more than ever vital in effectively meeting the major challenges facing our society. The resources mobilised for these purposes are fairly evenly balanced between fundamental research, research to support policy-making, and thematic research in a variety of economic, social and environmental sectors.

In 2001, these activities were complemented by the "Technology Attraction Poles" programme (TAP; 2001 - 2005) which is a dedicated research programme providing specific incentives to promote closer ties between research and development and to strengthen cooperation between universities and specialised sectorial centres.

On 14 October 2005, the Council of Ministers approved the second phase of the TAP entitled "Programme to stimulate knowledge transfer in areas of strategic importance" (TAP2; 2006 - 2011). This research programme aims at reinforcing the dynamics of innovation by capitalising on research potential developed at the national scale.

Besides the new phase follows on from the "Programme of Scientific Support for Standardisation and Technical Regulations" (NM; 1998 – 2003) which sought to promote Belgian involvement in all activities relating to standardisation and European technical regulations, thereby enabling Belgium to play a more important role in the process of European standardisation.

Objectives

Phases 1 and 2 of TAP are based on the development and use of scientific and technological knowledge that will give rise to methods, processes and tools capable of generating innovation in the industrial sector at the national scale.

This research programme aims to:

- consolidate scientific and technical potential in areas of strategic importance;
- stimulate the transfer of knowledge and research results to all socio-economic and environmental sectors, enabling them to make the most of available opportunities according to their constraints and specific needs, and thereby bring about the benefits of innovation;
- promote and support Belgian involvement in all international, and especially European, activities in these areas to ensure that Belgium plays an active role in ongoing developments, notably in the establishment of European or international codes and standards.

TAP
Technology Attraction Poles
Phases 1 and 2

Activities and research areas

The research areas common to both phases are the following:
- standardisation,
- telecommunications,
- space sector.

In addition to these areas, the new phase has been widened to include two additional areas:
- clean technologies,
- new materials.

The first three areas are placed under federal competencies. The last two areas are covered by a cooperation agreement between the Federal Authority and the Regions.

Research carried out under the TAP Programme must:
- take account of the needs of potential users;
- be innovative in character;
- constitute major axes for the integration of Belgium at the European level;
- adhere to the guidelines of applicable national and European legislation in the sector(s) addressed by the project;
- produce concrete and usable results in a relatively short timeframe.

Furthermore research carried out under the second phase must:
- be justified by socio-economic and environmental grounds in order to assess the feasibility of the project on one hand, and to predict outcomes and impacts on innovation, the environment and socio-economic aspects on the other hand.

Implementation

Each project is undertaken by an interdisciplinary network composed of 2 to 5 funded teams in phase 1 and 3 to 4 funded teams in phase 2. Each network includes at least:
- one university institution,
- a collective research centre (De Groote Centre or equivalent),
- and under phase 2, one Dutch-speaking partner and one French-speaking partner, so that the issues can be addressed at the national scale.

The partners have the possibility to associate themselves with teams from non-Belgian universities or research institutes. This participation takes the form of a 50% co-funding.

The programme is coordinated and managed by the Belgian Science Policy. It is assisted by a Steering Committee made up of representatives of the concerned federal and, in the case of phase 2, regional administrations. This Committee ensures consistency between programme activities and efficient transfer of programme results to external users.

Moreover each project is accompanied by a Follow-up Committee (called Users Committee in phase 1) composed of potential users of the results such as representatives of the public authorities at national, regional, European or international level, social stakeholders, scientists, industrial actors, etc. The committee's remit is to provide active oversight of the project and to promote valorisation of the research. It carries out this role via the exchange and provision of data and information and by giving advice, suggesting valorisation avenues, etc.

Projects

Phase 1

- Performance assessment of coating systems for exterior wooden joinery (ASSESSWOODCOAT)
- Flexible, organic solar cells for power generating textiles (SOLTEX)
- Traceability rules and actions against counterfeiting for international normalisation groups (TRACING)
- Coping with health, environmental and safety aspects in standards for machinery (CHASM)
- Controlled straining tests for the adhesion and damage resistance of laser claddings (COSTA)
- Static and dynamic design analysis procedures for structures with uncertain parameters
- Rapid prototyping and manufacturing for space components

Phase 2

- An aluminium alloy improved by the ECAP processing and shaped by the incremental forming SPIF (ALECASPIF)
- Innovative joining of critical aluminium structures with the friction stir welding technique (CASSTIR)
- Intelligent materials for energy conversion, storage and savings through soft chemistry (CHEMAT)
- Functional properties by mixed nano organic/metal oxide systems (FOMOS)
- Horizontal evaluation method for the implementation of the construction products directive (HEMICPD)
- Low energy housing retrofit (LEHR)
- Nanoceramics and their composites: processing by field assisted sintering technology (NACER)
- Stretchable and washable electronics for embedding in textiles (SWEET)
- Towards an integrated acoustical and thermal approach of buildings (TIATAB)

Performance assessment of coating systems for exterior wooden joinery (ASSESSWOODCOAT)

Context

The Belgian technical specification STS 52.04.08 “HOUTEN BUITENSCHRIJNWERK - Bescherming en afwerking / MENUISERIES EXTÉRIEURES EN BOIS – Protection et finition” needs extension, refinement and revision.

New kinds of paints with less or no solvents, like water-borne or high-solid finishes, have been developed. The properties of those paints are not extensively studied as those of conventional solvent-borne paints. In particular, the performance and durability of these paints and their ability to protect the underlying wood have been studied poorly.

Project description

Objective

The main topic of the research “ASSESSWOODCOAT” was to establish an assessment methodology for wood coating systems (paints and semi-transparent stains).

Methodology

To identify exterior coatings with “bad” performance, those with “adequate” performance and coating systems outperforming a range of coating systems with “known” performance in practice were weathered using natural and artificial ageing. Low VOC (Volatile Organic Compounds) waterborne coatings are emphasized. Paints and stains are both used in the set up. Paints are all opaque white systems while stains are brown coloured semi-transparent.

The joinery producers chose nine commercial wood species. The wood species were categorised into three groups, depending on the degree of difficulty for the finish, the specific requirements of the joinery producer and the sensitivity to blue staining of the wood. The combination of 9 wood species and 35 coatings resulted in 54 coating systems under test. Of each coating system 6 window frames of 1m² outer size were made. In total 324-finished window frames were included.

Three frames of each wood coating system were exposed to natural weathering. Three frames were sawn into samples used in laboratory testing. Based on optimized artificial ageing systems (UVCON and WOM) it was possible to rank coating systems and to use this for a temporarily approval which could become definite using data from long-term natural weathering.

Interaction between the different partners

The interaction between the joinery and the coating producers was guaranteed by combining each joinery producer with a coating producer. Discussions with the individual joinery or coating producer or with both of them together resulted in the selection of the coating systems. The joinery producers decided on the wood species to be used in the project. The coating producers provided for most recent relevant coating systems. The decision on who was going to apply the coatings and which application method was going to be used was in the hands of the Users Committee too.

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Results

The research was based on the European (pre)standards (CEN) about coatings for exterior wooden joinery. There are some specific requirements for the approval of a wood coating system. Data gathered by laboratory testing were related to the results after one and a half year outdoor exposure.

The global evaluation consists of five components. The weathering and assessment of the coating system on flat elements forms the first part. In this respect natural as well as artificial weathering can be used. Secondly a set of parameters describing moisture dynamics, adhesion and minimum criteria for erosion phenomena is proposed. These parameters are related to the most vulnerable parts of wooden window joinery. The third part is the more informative part. An extended dataset gives more information about layer thickness, gloss and colour changes. The fourth component treats the biological aspects as susceptibility to blue stain and moulds. At last the topic of maintenance should be mentioned in the fifth component.

A well performing wood coating system can be defined as a system where limited erosion in the vessel lines can be observed after 18 months outdoor exposure. In some cases blue stain is present but limited to maximum 10% of the surface. Coatings close to vulnerable parts e.g. water outlets, corner joints and sharp ridges will degrade to a less extent.

Ten weeks of artificial ageing are sufficient to assess transparent systems while 16 weeks artificial weathering is required to assess opaque systems.

The results of each wood coating system are incorporated in a specific template including the critical values. A photo of the system after 18 months outdoor exposure is added.

The proposed evaluation criteria for critical as well as for non-critical parameters will be used to finalize the STS 52.04.08 “HOUTEN BUITENSCHRIJNWERK - Bescherming en afwerking / MENUISERIES EXTÉRIEURES EN BOIS - Protection et finition”.

A summary of the report may be downloaded from the CTIB-TCHN web (http://www.ctib-tchn.be/main_ctib/frames/F_news_F.htm).

Users Committee

Coating producers

Sikkens ■ Arch Timber Protection ■ Boss Paint ■ Glasurit ■ Sigma Coating ■ T & G bvba ■ Vendart bvba

Joinery producers

Camba ■ Engels ■ Hardy ■ Sibomat ■ Smets Houtbedrijf ■ Wyckaert Houtconstructies ■ Grootjans

Miscellaneous

FPS Economy, SMEs, Self-employed and Energy – Quality Building (Approval and technical specifications) ■ ABPB-BVHB

Flexible organic solar cells for power-generating textiles

(SOLTEX)

Context

Functionalized textiles are increasingly being introduced in the medical, sports, leisure and other market segments, forming a welcome diversification for the high-tech Western textile industry. The development of a flexible organic (plastic) solar cell, integrated with textile surfaces by lamination technology, perfectly fits in this strategy and is of a large strategic importance for Belgian industry with a strong background in solar energy production, organic electronics and high-tech textile industry.

Project description

Objective

It is the objective of the SOLTEX project to develop a flexible organic (plastic) solar cell that can be integrated with textile surfaces by lamination technology.

Solar cells are autonomous power-generating devices that can be used in a wide variety of conditions and environments. To be useful for portable and wearable applications, they must be thin, lightweight, flexible and low-cost. These features have very recently become possible thanks to the revolutions brought by the introduction of organic (also called plastic) electronics. Textiles are omnipresent surfaces with significant area that could be used as substrate for portable and wearable power generation.

Methodology

The work in this project is divided in two main actions. On the one hand, we start from proven organic solar cell technology and adapt this in order to obtain a solar-cell sheet that is suitable for lamination with textiles. On the other hand, we selectively replace certain parts of the solar cell in order to improve its performance in the demanded – mostly outdoor – environment. The performance figures that have to be improved are the outdoor lifetime and efficiency. The two main tasks that are foreseen for this purpose are:
(1) the design, synthesis and introduction of new organic electronic materials (discotic liquid crystal materials, fluorene-based and thiophene-based copolymers) for improved carrier conduction, absorption of sunlight and stability;
(2) the development of technology for encapsulation of flexible solar cells with polymer barrier layers.

Partners

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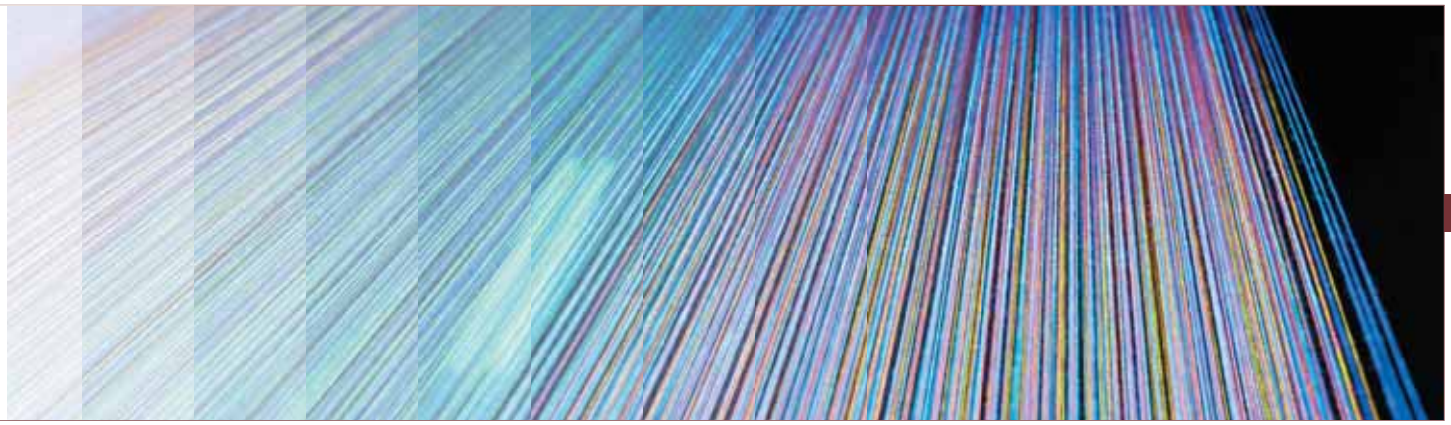

Results

Interaction between the different partners

Successful research and development in this area clearly requires a multidisciplinary team: plastic electronics is located at the borderline between chemistry and electronics manufacturing, and the integration with textile adds the latter industry to the mix. We have in this consortium clustered the research groups with international reputation in these fields. The large industrial Users Committee testifies the genuine interest by the industrial players in the different fields involved (film, chemistry, textile, electronics, photovoltaics).

The results of this project include:

- stimulation and profilation of Belgian multidisciplinary research in the field of electronics for the information society and in the field of functionalized textiles,
- generation of methods, practices and measurements as groundwork for standards in power generation for portable and wearable electronics,
- protection of intellectual property generated in the project in the area of materials for organic electronics and in the field of new textile technology.

To illustrate and promote the project a demonstrator was worked out by the project partners Centexbel and IMEC, in collaboration with the Users Committee member Samsonite. A suitcase with a textile part was used to integrate a small LCD display powered by solar cells. To illustrate the difference between the state of the art in flexible solar cells, an amorphous silicon based solar cell was placed next to a fully organic solar cell made by IMEC. The textile part of the suitcase was digitally printed with a custom designed illustration including the logo's of all partners and the Belgian Science Policy. The suitcase was shown on the Centexbel booth at Techtextile 2005 (Frankfurt, G) and at Flanders Textile Valley 2005 (Kortrijk, B) where Centexbel also organised it's "Technologiedag". A similar suitcase is be made for IMEC to show in their exhibition room.

Furthermore, the consortium has published several scientific results from the SOLTEX project and a process to obtain spincoated phthalocyanine films which display homeotropic alignment is the object of a patent which was deposited by ULB on May 15, 2005, with the number 05447108.1.

Users Committee

3E ■ Agfa ■ BarcoView ■ Bekaert (business unit: Advanced Materials) ■ Calcutta NV ■ Febeltex ■ Photovoltech ■ Samsonite ■ Sioen Fabrics ■ Soltech ■ Solvay ■ UCB ■ Umicore ■ Vetex

Traceability rules and actions against counterfeiting for international normalisation groups (TRACING)

Context

"Counterfeiting is a major threat for the European global economy." This is a conclusion from a recent report from the European Commission. The volume of sales coming from the counterfeiting business represents between 5 and 7% of world trade, which means revenue about 250 billion euros par year. The consequence for the European society is an estimation of 200000 job losses. However, current and new ICT technologies could bring solutions in the fight against counterfeiting. And this is just the aim of this project: explore new information embedding techniques on physical objects to fight counterfeiting.

Project description

Objectives

This project aims at studying innovative techniques for protecting two kind of commercial products against counterfeiting: textile fibers and fabrics on one hand, and manufactured goods containing a thermoplastic substrate on the other hand. The idea is to try to embed identification information directly on material surfaces, using micro and nanotechnologies (coating). The information would be encoded by means of special patterns. In both cases, the protection against copy would be based on cryptographic techniques and on the complexity and cost of the coating equipment. Finally, this project addresses standardisation issues at different levels, with possible actions at the European level in active groups such as CEN, EAN or ETSI. The standard definition of the identifiers is needed for interoperability reasons.

Methodology

Designing an information embedding technology for tracing and anti-counterfeiting purposes requires to perform research on embedding techniques, on the spatial and geometrical information coding, on the physical replication techniques together with the information protocols and protection, and on finally the design of the information retrieval procedure and electronic read-out device.

Classical photolithography techniques were used for the design of nickel inserts to be placed in moulds and to replicate the physically encoded information at a micrometric and sub-micrometric level on the surface of thermoplastic manufactured goods via injection moulding. In parallel, the ETRO laboratory at the VUB performed research on the 3D watermarking approach for 3D physical information embedding. Multitel developed in parallel, closely collaborating with UMH and VUB, the physical embedding technique, the information physical coding and the information retrieval device based on reflective

Partners

Activities

- Multitel: founded by the "Faculté Polytechnique de Mons". It has a large expertise in signal and image processing;
- UMH-CRMM: CRMM has a large expertise in the study of molecular properties of surfaces and particularly physico-chemical properties and interfaces between liquids and solids;
- Sirris: research centre of the industry with a large expertise in thermoplastic materials;
- Centexbel: Belgian research centre for the textile industry;
- VUB-ETRO: ETRO has a large expertise in image and signal processing, inclusive 3D watermarking.

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Results

surface laser optical methods, and image processing techniques. Finally Centexbel studied the transposition of all these techniques of thermoplastic objects to textile fibres.

Interaction between the different partners

Each partner let its own expertise penetrate in the many different areas covered by the project. UMH brought its expertise in micrometric and submicrometric patterns generation, for information embedding, and especially with photolithography techniques for mould masters design. It worked in close collaboration with Multitel and VUB-ETRO who were in charge of the physical coding of the information and the 3D watermarking techniques. Sirris (previously CRIF/WTCM) brought it expertise in thermoplastic materials and replication techniques. Finally Centexbel brought its know-how to transpose the research results to the textile fabrics and textile industry, together with its expertise in standardisation activities.

- A complete technique for embedding information on the surface of plastic objects was developed together with the technology (device) for retrieving the information.
- A protocol for authenticating the objects and distinguish them for counterfeited ones was also developed and validated with the Users Committee.
- A laboratory prototype was tested and the technique was validated.
- The whole process, and especially the technique for embedding information on the surface of the plastic objects at a sub-micrometric level, completely invisible to the naked eye, and without modifying the aesthetic properties of the objects was patented:
  - a US preliminary submission on July14, 2006 under the number US60/831,061 and with the following title: “Anticounterfeiting Method and Device Based on Direct Information Embedding and Retrieval on Manufactured Plastic Goods”;
  - a European patent submission filed on January 19, 2007, under the number 07100863.5 and the title: “Authentication Method and Device for Protecting Manufacturing Goods”.

Users Committee

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The following companies/institutions formed the Users Committee:

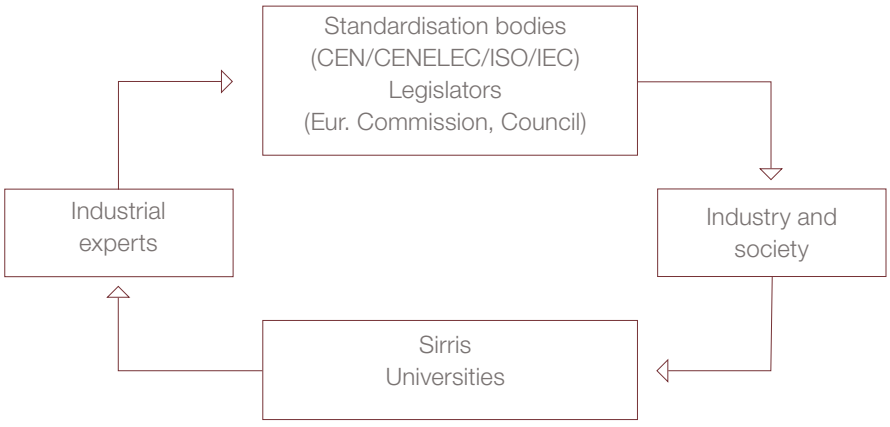
Signatiss S.A. ■ Febeltex ■ Bopack Systems ■ CHEP ■ KMO-IT ■ GTI-Group ■ UCL/CRYPTO ■ FPMS/TCTS ■ Barco Vision ■ GlaxoSmithKline ■ LASEA.

Coping with health, environmental and safety aspects in standards for machinery (CHASM)

Context

The Sirris research centre (previously WTCM-CRIF) and it's University partners are faced with the facts that:

- a lot of companies still have a lack of knowledge about the existing technical regulations and their related standards. They also want to be informed about the new technical directives and standards;
- there is not enough support towards industry from research centres and universities concerning the practical application of these regulations and standards. The industry asks for solutions in order to make their products conform to directives and standards;
- as to future directives and standards the experts of research centres and universities are not enough involved in the legislation and standardisation process. Future legislation and standardisation are very important to industry because they will determine the way their products will be built tomorrow;
- the research at the universities (technological and prenormative) is not always in line with the requirements of the future directives and standards. There is no proper dialogue between industrial experts and universities and Sirris.



Project description

Methodology

To solve the shortcomings the respective tasks within the workpackages were:

- to inform industry by promoting standardisation and technical regulation as a useful economic and social tool that has the potential to play a larger role in protecting the environment and the health and safety of workers. This will be done by organising seminars throughout the whole country;
- to transfer the knowledge and the results of research towards more applicable projects. This will be organised by the means of specialised international seminars and specific projects triggered by the Belgian industry, formulated by companies in the Users Committee;
- to participate in the standardisation activities of the Technical Committees of CEN/ISO, CENELEC/IEC related to

Partners

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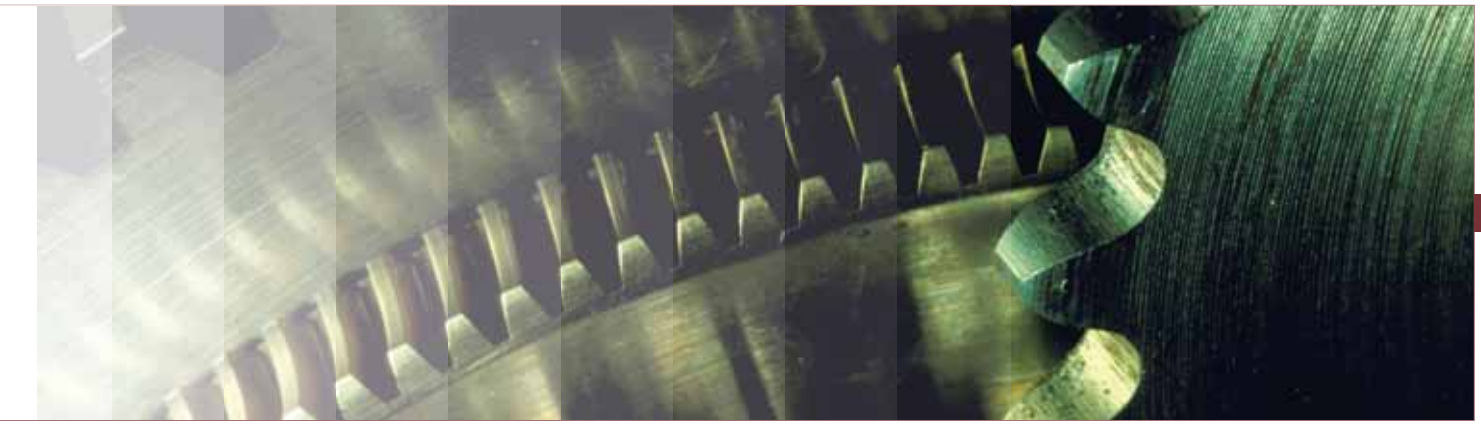

each workpackage and to participate in the stakeholders meetings of the European Commission, international forums and the National Ministries regarding the future legislation;
- to create a dialogue between the industrial experts and the universities and Sirris so that the research programs will be more focussed on the technological challenges of the new directives and standards.

Objective

The project aimed to contribute to standardisation in the mechanical and mechatronical field which has an impact on the environment, health and safety. The investments of industry to make the machines more environmentally friendly and safer are very large and contribute to the benefits of the individual and whole society.

Results

There has been:
- 30 publications and 9 scientific missions and 15 meetings related to the noise and vibration research,
- 7 publications and 12 scientific missions related to the lifecycle environmental aspects research,
- 9 reports, 22 publications and 22 scientific missions related to the engine emissions research,
- 3 publications and 17 meetings related to the research on health and safety aspects of machinery,
- 9 publications and 11 scientific missions related to electromagnetic compatibility health and safety aspects.

Users Committee

Case New Holland ■ Green Propulsion ■ CES ■ Anglo Belgian Corporation ■ Atlas Copco ■ Daikin ■ ACV

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Controlled straining tests for the adhesion and damage resistance of laser claddings (COSTA)

Context

Recent developments in coating technology enable the deposition of strongly adherent thick (>50 µm) coatings. Metal matrix composite coatings deposited by laser cladding (LC) containing carbides are ideal for components subject to heavy abrasive wear. Another example of a very promising coating technique for light metals is the plasma electrolytic oxidation. Adhesion and damage resistance is improved drastically compared to the classical thermal sprayed coatings.

Most existing adhesion test methods however are at best semi-quantitative assessments of coating/substrate adhesion and are not standardised. A few tests are suitable for thick coatings, but are able to measure adhesion only of weakly adhered coatings. A method for measuring the adhesion of good adherent coatings was lacking.

Project description

Objectives

The COSTA project aimed to validate simple and cost effective controlled straining tests. The ultimate goal of the project was to attain a quantitative, accessible and standardised method for the determination of damage resistance and adhesion of thick hard coatings on metals.

Methodology

A number of selected thick wear resistant coatings has been deposited during the project. They have been characterised and their mechanical properties, microstructure and chemical composition determined. It is evident the characterisation is indispensable for a better understanding of the adhesion of the coatings. A survey of all viable mechanical characterisation methods has been made.

After a scan of potential (existing) adhesion tests, a completely new test method had to be developed: the strain induced delamination test. The test is based on the principle that a test sample can be made such that stable delamination occurs at a constant force during straining it in a tensile test bench. The adhesion can be derived from this constant force. Further research was however indispensable to determine by FEM modelling the exact interface toughness based on the force needed for the stable delamination. A round robin has been set up in order to validate the test method.

Interaction between the different partners

The international project team was composed of the following partners:

- VITO responsible of the laser clad samples and the characterisation,
- UCL responsible of the methodology and FEM simulations,
- Sirris (previously CRIF/WTCM) and BWI for testing and standardisation,
- University of Cambridge responsible of the PEO coatings, other adhesion tests and simulation of the stress in thick coatings.

Partners

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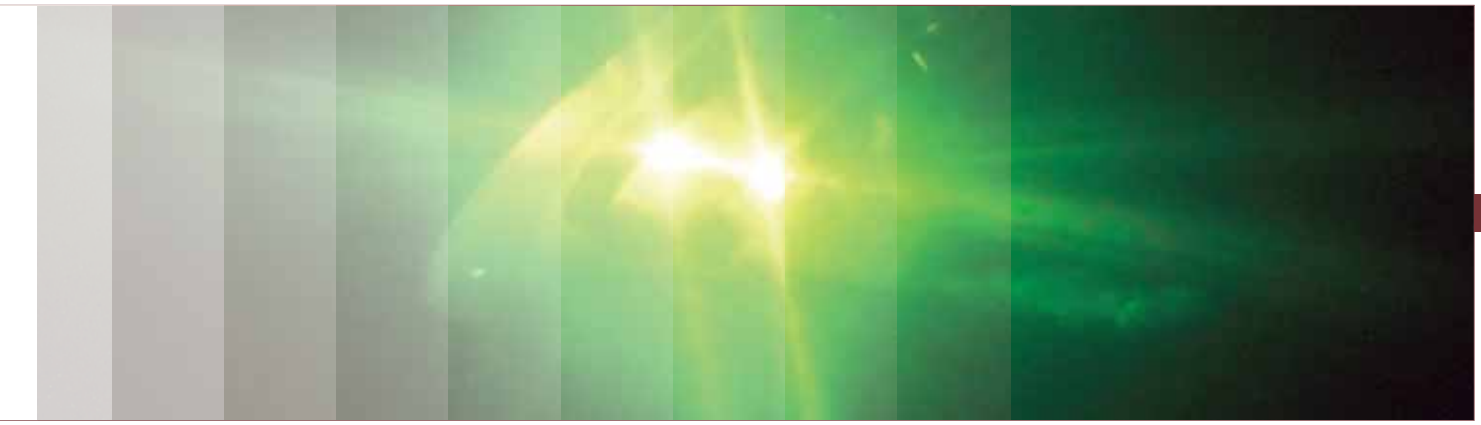
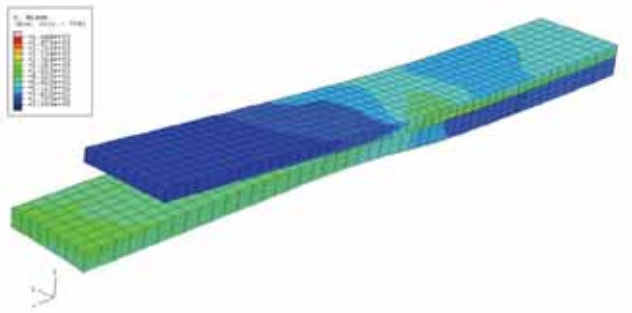


Results

- Guidelines for the measurement of mechanical properties of coatings;
- Overview of adhesion test methods for thick coatings;
- A new test method for well adherent thick coatings;
- The procedure for testing the coatings by the here developed strain-induced delamination test method has been proposed at CEN and a work item has been opened;
- FEM analyses have been set up and performed for the simulation of the interfacial toughness. This simulation tool is useful to derive quantitative values and to reduce the number of tests;
- Publications:
  - K. Van Acker, D. Vanhoyweghen, R. Persoons, et al., Influence of tungsten carbide particle size and distribution on the wear resistance of laser clad WC/Ni coatings, Wear, Volume 258, 2005, pp. 194-202
  - A. Plati, J.C. Tan, I.O. Golosnoy, R. Persoons, K. Van Acker, T.W. Clyne, Residual Stress Generation during Laser Cladding of Steel with a Particulate Metal, Adv. Eng. Mat., 2006, 8, No. 7, pp. 619-624
  - S. Ryelandt, L. Delannay, R. Persoons, K. Van Acker, F. Delannay, Measurement of the debonding resistance of strongly adherent thick coatings on metals via in-plane tensile straining, Adv. Eng. Mat., 2007, accepted
  - K. Van Acker, Geïnstrumenteerde rektest voor de hechting en scheurgevoeligheid van laser claddings (Costa), VOM info 05/06, pp. 5-9



FEM simulation of stresses during decohesion of a laser cladded 304 stainless steel

Users Committee

The Users Committee consisted of job coaters and end users of thick wear resistant coatings:

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Static and dynamic design analysis procedures for structures with uncertain parameters

Context

As an alternative to approximative design procedures involving safety factors dating from the era of manual calculation, nowadays the finite element (FE) method is a powerful tool to verify static and dynamic structural behaviour.

However, the FE-technique is purely deterministic. To deal with the omnipresent uncertainties on model parameters (materials, loads, geometry, constraints...), an alternative to probabilistic methods is proposed for cases where probabilistic data is incomplete or simply unavailable.

Project description

Objectives

The objective of this project was to develop a consistent and applicable methodology to take into account the effect of parameter uncertainties, by using only real physical and geometrical properties of the structure. The approach should be consistent: it should be developed in an analytical framework that is as close as possible to the existing FE methods. The approach should be also applicable: the user should be able to apply it without much further knowledge of non-FE techniques, and the analysis should not require excessive calculation times. The project focused on both static and dynamic design procedures.

Methodology

The methodology applied in the project was based on the representation of uncertain model parameters by intervals or fuzzy numbers. The Interval FE (IFE) analysis is based on the interval concept for the description of non-deterministic model properties: a finite element model parameter may be represented by an interval number. Numerical operations use interval arithmetic.

Interaction between the different partners

KUL-PMA and KUL-BWM were the developing partners in the project. Gathering information, set up of test cases en tests of real cases is performed by the two developing partners in combination with Sirris (previously CRIF/WTCM) for mechanical & automotive cases, with BBRI for civil cases and with CSL for (dynamic) cases of space-structures.

Partners

Activities

All partners are researchers active in the validation of designs using FE-techniques, each of them focusing on specific sectors: civil construction, mechanical & automotive design, aircraft & space design.

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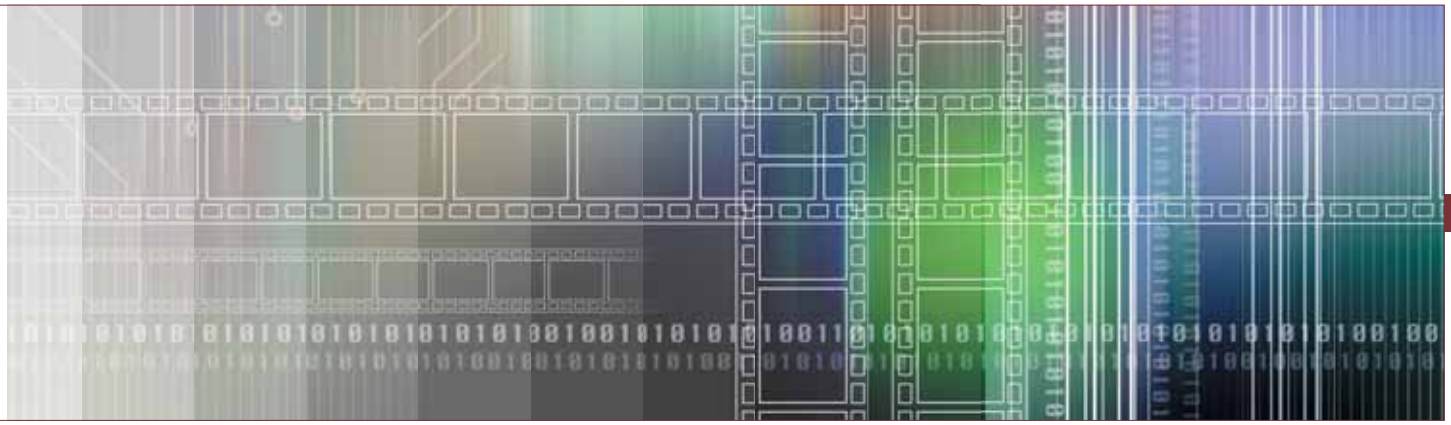
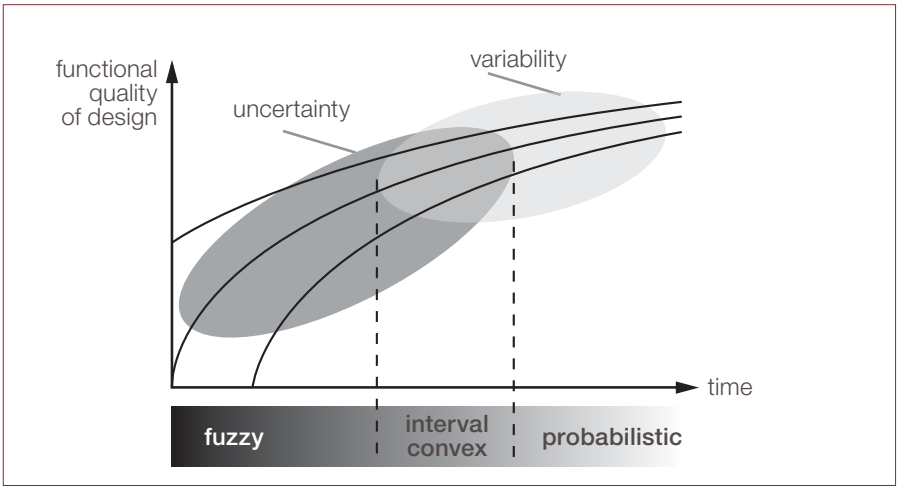


Results

In the early stage of the project, the emphasis was on identification and quantification of sources of uncertainty that are commonly present when performing static or dynamic structural analysis. Non-determinism is frequently found affecting several parameters, such as material characteristics (Young's modulus, mass density), damping characteristics, geometry, loading and connection characteristics (boundary conditions, joints, etc). A general classification was applied that distinguishes between on the one hand variability in model properties actually occurring in the physical product, and on the other hand, uncertainty in the model due to lack of knowledge. This classification forms the basis for the selection of the most appropriate tool for the numerical treatment of model non-determinism. In this context, generic guidelines were formulated concerning the use of probabilistic and non-probabilistic tools (fuzzy, interval methods). As illustrated in the picture, the non-probabilistic concepts are concluded to be of most value in early stages of the design.



Application of different concepts for uncertainty modelling in a classical design procedure

In the principle part of the project, a fuzzy finite element framework was implemented for static and dynamic structural analyses. This fuzzy framework allows an analyst to describe model uncertainty in terms of vague or linguistic terms. No exact probabilistic description is required. Different methodologies were adopted for the implementation of the framework, including a design of experiments based approach and global optimization strategies. For this purpose, custom MATLAB-routines were written that interact with well-known FE-solvers (MSC.Nastran, ANSYS). The developments enable the propagation of fuzzy model uncertainty to the corresponding uncertain fuzzy analysis results. The framework was validated based on real-life industrially sized test cases from the Users Committee, including the analysis of the dynamic behaviour of truck models, satellite structures and civil structures.

Finally, practical guidelines were formulated for the assessment of non-determinism typically encountered in finite element models built for the static and/or dynamical analysis of mechanical structures. Depending on the available information and the purpose of the analysis, one non-deterministic approach can be more appropriate than others.

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Each member of the Users Committee has a wide experience in the analysis and/or the design of structures. They play an active role in feeding the research partners with experience, practical data and real-life cases. They are active in different industrial sectors (civil, mechanical & automotive, space), and in different types of activities (research, services & consulting, software, component manufacturer, end user):

AMOS S.A. (Advanced Mechanical & Optical Systems) ■ Arcomet N.V. ■ Belgian Welding Institute (BWI) ■ Case New Holland ■ DAF Trucks (The Netherlands) ■ Dutch Space BV (The Netherlands) ■ ESA-Estec (The Netherlands) ■ IMEC vzw ■ Jonckheere bus and coach N.V. ■ LMS International ■ OIP N.V ■ Probabilitas N.V. ■ SAMTECH S.A. ■ SCIA Group N.V. ■ Belgian Nuclear Research Centre (SCK-CEN) ■ Technical Control Bureau for Construction (SECO) ■ Technum N.V. ■ Tenneco Automotive Europe N.V. ■ TU Delft ■ Van Hool N.V.

Rapid prototyping and manufacturing for space components

Context

Single component manufacturing is a typical need in the spatial sector, being extremely costly with the classical manufacturing techniques like injection moulding, investment casting or five-axis milling, etc. Rapid Manufacturing (RM) is an emerging technology offering solutions to this manufacturing problem. Belgium is explicitly present in the international research.

Project description

Objectives

The technical objective of the project is to borrow generic technologies from the domain of "rapid prototyping" (RP), "rapid product development" (RPD) and "rapid manufacturing" (RM) and to apply, adapt and further develop those technologies to make them applicable to the development and fabrication of prototypes and components for the spatial sector.

Methodology

During the project a network of organisations and industries is established. In this network, all members have shared their needs, requirements and solutions in the domain of RP, RPD and RM for spatial applications.

The project deals with topics in different stage with respect to time-to-market: from basic research on new technologies to real, functional case studies. The network is set-up to support this.

Interaction between the different partners

The complementarity of the three partners appeared to be ideal: KULeuven is equipped very well for basic research, Sirris (previously CRIF/WTCM) has a huge infrastructure to elaborate case studies and CSL has a difficult-to-equal experience in testing for space applications. Communication on these technical subjects is another important issue. In the first instance, users have oriented the project by formulating their wishes. To the end, the research partners have communicated the results through meetings, lectures and discussion about the case studies.

All partners and users are involved actively in international research programs and space programs, resulting in a huge knowledge available.

Partners

Activities

- KULeuven-PMA: university, research division for non-conventional production technologies,
- Sirris (Seraing): research division to support industrial companies in Belgium,
- CSL: research institute of the University of Liege, in the scope of space, especially with respect to optical systems.

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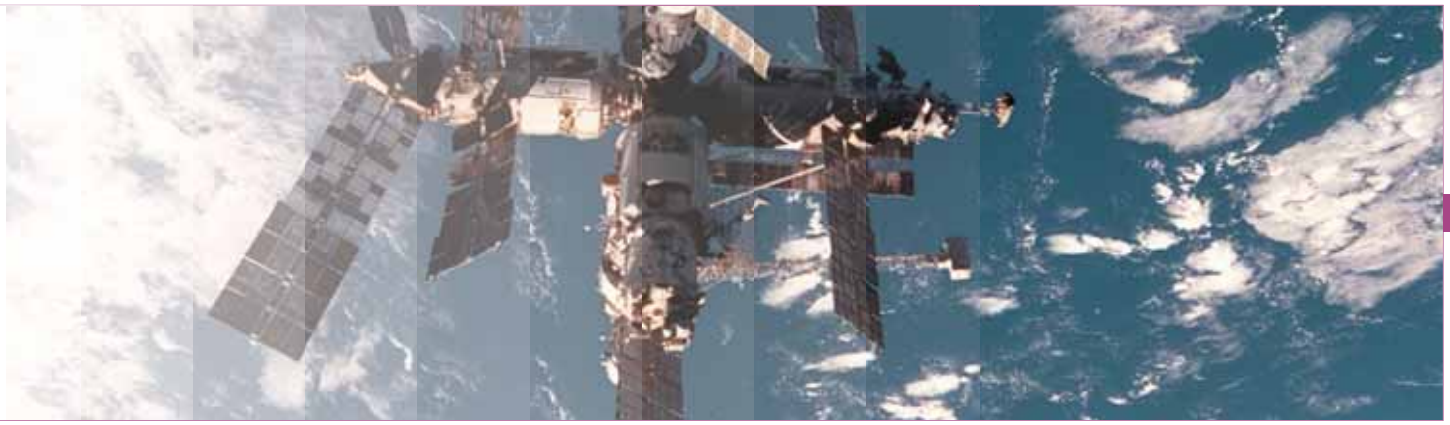

Results

The research has resulted in various results:

- needs, requirements and initial specifications have been gathered;
- a series of tests is performed on produced components, with respect to space applications, e.g. out-gassing;
- different processes have been optimised (stereolithographie, optoform, SLS & SLM and 3D-jetprinting);
- detailed research was carried out for light weight structures;
- more than 10 case studies have been elaborated;
- the results, findings, design rules, etc. have been collected and communicated to the involved parties. Two patents have been filed.

Users Committee

Techspace Aero ■ OIP Sensor Systems ■ Verhaert (Kruibeke) ■ AMOS ■ Sonaca ■ Lambda-X ■ Sabca

Industrial developer: Materialise

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An aluminium alloy improved by the ECAP processing and shaped by the incremental forming SPIF (ALECASPIF)

Context

Aerospace serial production is not comparable to that of wide use products such as cars for example. Several small parts with complex shapes have to be produced in rather small series, which makes the cost of the tooling a significant percentage of the overall cost of the part itself.

Therefore, the development of SPIF process, which does not require the development of expensive tools and which allows rapidly manufacturing prototype parts in a design phase is of major interest for aerospace industry.

Project description

Objectives

The availability of improved materials combining a low specific weight with high strength and stiffness properties, as can be provided by Equal-Channel Angular Pressing (ECAP) treatment of selected alloys and the Single Point Incremental Forming process (SPIF), an emerging flexible forming technique characterised by extremely high achievable strain levels compared to conventional forming methods offer valorisation potential in terms of reduced manufacturing costs, due to significantly reduced tooling requirements, lead time reductions and weight reduction of the components, which forms a major life cycle cost advantage.

Methodology

The interest of the SPIF process will be investigated in a first step on the new alloy without ECAP process. In a second step, other tests will be performed on smaller parts perhaps scaled aeronautical part in material manufactured either by a modified ECAP process, or by ECAP + Rolling processes. The possible coupling with a local laser heating process will be investigated if required. It is well known that ECAP process materials are hard to form as well as that SPIF process can induce higher strains than classical deep drawing.

Partners

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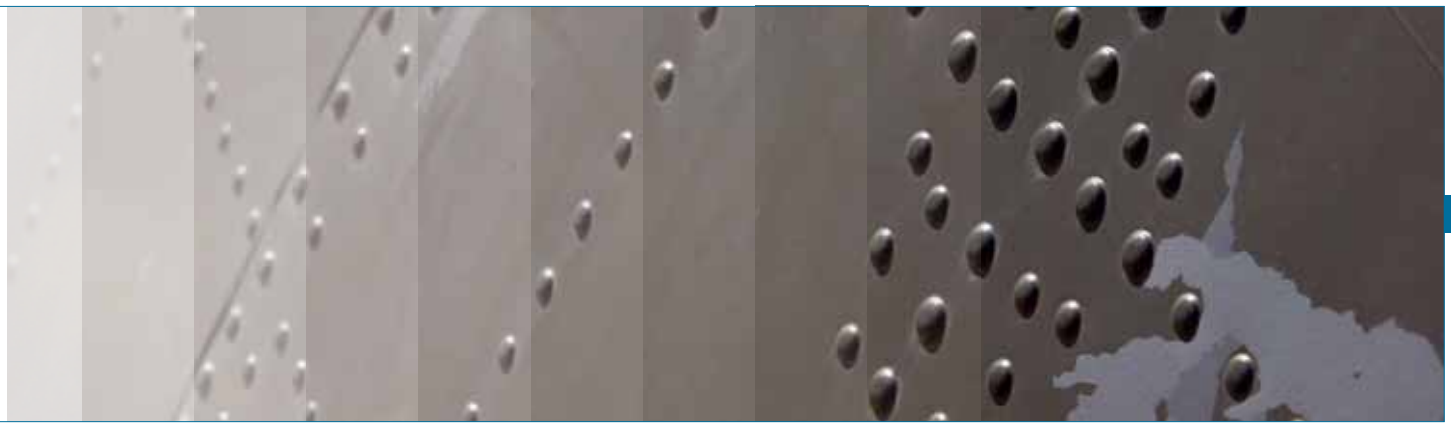

Results

Interaction between the different partners

- ULg develops and identifies numerical material models for initial and ECAP material and simulates the SPIF process. As project coordinator, ULg assumes the project management.
- KULeuven designs and produces a new ECAP device. He performs microstructural identification and macroscopic tests after ECAP, after rolling by CRM and after SPIF, investigates SPIF processing and the formability of the initial and the ECAP materials, he provides aeronautic parts as well as cut samples in these parts to allow their characterisation.
- CRM performs the initial material characterisation, he studies the effect of rolling, he performs microstructural identification, macroscopic tests, fatigue tests and is in charge of producing the stiffeners.
- US investigates a modified ECAP method producing sheets without further rolling, he provides submicron material in sheet. He performs microstructural identification and macroscopic tests of his ECAP sheets.

Expected results and/or products

Coupling the SPIF process and an ECAP material should result in a global solution: a higher yield stress material with its adapted forming process.

Contribution of the project in a context of support to innovation and transfer of knowledge

The result dissemination will be quite effective by publications in international journals: Journal of Engineering Manufacture, Scripta or Acta Materialia, International Journal of Plasticity… and presentations in international conferences like ESAFORM, Shemet, Metal Forming, Complas, Numiform, Numisheet, …

Follow-up Committee

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Innovative joining of critical aluminium structures with the friction stir welding technique (CASSTIR)

Context

Welding is generally recognised as a major critical step in the production of a metallic structure. Profitability needs to be coupled to optimum joint properties. Moreover, with good reason larger attention goes out to the environmental soundness of the welding processes. Friction stir welding (FSW) is a joining technique with provides a solution to all these concerns, and it is perfectly suited for welding of aluminium alloys.

Project description

Objectives

CASSTIR aims to demonstrate the capabilities and limitations of FSW applied to a number of different cases. The joint characteristics will be studied into detail (including fatigue, corrosion and residual stresses) as function of the welding parameters. The influence of the used FSW equipment on the parameters will be examined. All this will serve as input data for numeric modelling, and should lead to the drafting of guidelines and good practice rules. Demonstration pieces will be produced, and a comparison with be made with an alternative production process, in terms of environmental impact and economic feasibility.

Methodology

The main obstacles for industrial application of FSW in Belgium are the unawareness of its capabilities and advantages, and the high investment and license costs. Based on the Follow-up Committee recommendations, two aluminium alloys are selected with differing and sufficiently broad domain of application. Determination of the optimal parameters for the realisation of FSW demonstration pieces is based on a detailed investigation of FSW test welds. Modelling should assist this determination. A comparison in terms of properties, costs and environmental friendliness will be made with currently used production techniques.

Partners

Activities

UCL-PRM has the largest academic knowledge of FSW in Belgium, while the research centre CEWAC possesses 2 advanced FSW machines which serve the needs of diverse companies. The BWI has decades of experience in terms of welding processes, technological guidance and elaborate weld characterisation. The academic and industrial knowledge at the Corrosion Department of UGent will allow analysing the corrosion behaviour of the welds in detail.

Coordinator

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Results

Interaction between the different partners

UCL-PRM and CEWAC are the only 2 Belgian research institutes in possession of FSW equipment. Their apparatus is complementary, so the research executed within this project is of great importance, both for the academic world as for the Belgian aluminium-processing industry. CENAERO, subcontractor to UCL-PRM and CEWAC, is responsible for the modelling of the process and the weld behaviour. The BWI and UGent carry out the major part of the weld characterisation (mechanical behaviour resp. corrosion properties). The BWI also takes charge of the role of coordinator of CASSTIR. Throughout the years, fruitful collaborations were already formed between the partners in various projects.

Expected results and/or products

It is expected that, supported by the project results, on a 5 year term at least 6 Belgian companies from sectors such as transportation, automotive or aerospace will make use of FSW as manufacturer, subcontractor or client. Through the experience generated within the project, the research partners will be able to assist these companies during the concrete implementation.

Contribution of the project in a context of support to innovation and transfer of knowledge

This project aims at introducing the ecologically sound friction stir welding technique into the Belgian aluminium processing industry. The project will support these innovation-minded companies, not only by means of delivering input data and guidelines, but also through a contribution to the international standardisation efforts (ISO, EN, IIW) concerning this joining technique.

Follow-up Committee

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This list can be extended. The project aims at suppliers of semi-finished products, manufacturers and potential clients, research institutes, and all other instances which may benefit from the knowledge and transfer of the results generated within the project.

Intelligent materials for energy conversion, storage and savings through soft chemistry (CHEMAT)

Context

Recent advances in solid-state chemistry have resulted in substantial progress towards achieving a better understanding of the solid state, and have even led to the development of new predictive capabilities in crystal chemistry. Entirely new ways of preparing and studying advanced materials have resulting in pursuing the so-called "soft chemistry" approach to materials science and technology, getting access to a control of microstructure and heterogeneities at the nanoscale level.

The current proposal will substantially enhance the research activity in the field of energy conversion, storage and savings through the development of novel oxide materials by soft chemistry processes. Existing competence in the ULg, CRIBC-CWOBKN and UGent partners covers all the scientific and technical aspects of the proposal, from the production of prototypes through soft chemistry processes to the physical measurements of the properties, and finally to their use in specific applications.

Project description

Objectives

The research will include the preparation and analysis of novel oxides and their use as potential candidates for the design of efficient energy storage or converting systems. As the introduction of clean technologies for energy production and storage has become a major concern throughout both industry and academia, oxides are presently undergoing an upsurge of interest as heat-to-electricity converters, superconducting magnetic energy storage systems, batteries,.... As ULg, CRIBC-CWOBKN and UGent partners are also the stepping stone from bench to pilot plant, research will also include many engineering techniques (both chemical and electrical), like the device conception, its operation in a severe environment (for space applications for example) and the use of modelisation.

The relevance of the project is immediate and even double: the project aims at studies involving (i) the design and development of advanced engineering materials in an original research plan, and (ii) the use of energy and environment friendly materials for sustainable energy. Deliverables cover the research and development of extremely efficient energy storage and conversion systems, of ecologically acceptable new chemistries for the production of intelligent materials.

The following socio-economic benefits are expected:

- to improve the perception of the chemical industry by the general public;
- to introduce innovative technologies and alternative solutions contributing to the resolution of the major challenges for the next decennia: clean energy and sustainable production technologies;
- to create new employment (the involvement of the chemical industry per head of the population is extremely high in Belgium and successful innovations may provide significant dividends in creating new employment);
- to provide the Belgian industries with a competence consortium on soft chemistry and materials technologies that will allow them to successfully compete with similar developments in other countries.

Partners

Coordinator

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Methodology

Three priorities have been identified:

- thermoelectrics based on cobaltite and related structures,
- high critical temperature YBCO-based superconductors,
- cathodic materials for Li-ions batteries.

To improve performances through a precise control of the synthetic pathway thanks to a “chimie douce” approach for controlling the structure constitutes the main objective of the CHEMAT project.

Hydrothermal synthesis, sol-gel processes and templating are the main chemical routes to be used for obtaining a material with specific characteristics like structuration and dimensionality.

Interaction between the different partners

The three partners have a long standing experience in “chimie douce” processes. ULg has developed the templating approach for a long time ago, UGent is one of the Belgian leader for sol-gel synthesis of thin films and CRIBC-CWOBKN is one of the national expert in the hydrothermal synthesis. ULg and UGent collaborate from a long time ago on the manufacturing of superconductors for long length conductors development. CRIBC-CWOBKN and ULg are very active in the field of oxide thermoelectrics. ULg has many activities related to the development of new materials as components of Li-ions batteries. The platform gives the insurance for success due to their competence in chemical synthesis of inorganic materials through soft chemistry processes and their shaping as well as physical tools for characterizing most of the physical and structural properties.

Expected results

- In the field of oxide thermoelectrics, the goal of the project is to build a prototype demonstrating the feasability of thermoelectricity to convert in a efficient way the thermal energy into electricity.
- In the field of superconducting high-Tc materials, the coated conductors (more than 10 meters long) made of thin films of YBCO-based superconductors on flexible metallic substrates have to perform critical current densities as high as 105 A/cm2 at 77K to be used in superconducting magnetic energy storage systems.
- In the field of next generation of Li-ions batteries, the expected results must concern the development of new materials with excellent properties of Li intercalation-deintercalation behaviour to be used as cathodic materials for operating more than 100 charge-discharge cycles.

Follow-up Committee

Centexbel ■ Cluster Auto-Mobilité ■ RW – DGTRE ■ Erachem – Comilog ■ Inergy Automotive Systems ■ IWT-Vlaanderen ■ Pôle VIC ■ Arcelor-Mittal

Functional properties by mixed nano organic/ metal oxide systems

(FOMOS)

Context

Metals are often coated with organic films (paints, adhesives, etc.) for various applications in packaging, transport, construction, amongst others. Compatibility between the organic medium and the metal substrate covered by its native oxide is crucial and required for durable properties.

Project description

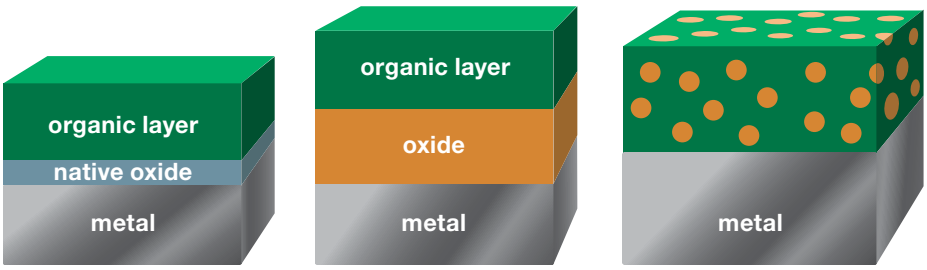
Objectives

The objective of the project is to gain better fundamental understanding of the compatibility and the interactions between inherently very different material phases at their connecting interfaces, that will lead to better understanding of their combined properties. Through the control of materials at the nanometer scale, new innovative structures can be tailored with an improvement of specific or multi-functional properties, such as optical, adhesion, barrier and corrosion properties.

Methodology

The considered components are a metallic substrate, a metal oxide phase and an organic layer. There are 3 systems that will be considered, as depicted in the figure below. System 1 is the reference system, which represents mostly the current status. In system 2 the native oxide is replaced by a very thin metal oxide, tailored to modify specifically the interfacial properties. In system 3, the metal oxide phase is present as nanosize particles embedded in an organic matrix. Deposition is done either by wet or plasma deposition.

The research approach consists of three main steps: comparison of film deposition methods, system characterization and property analysis.



System 1 *System 2* *System 3*

Partners

Activities

- VUB: surface engineering, modification and quantitative characterisation of materials' surfaces and interfaces;
- ULB: interactions between plasmas and surfaces, with an emphasis on the functionalization of polymer surfaces, deposition of coatings, and surface treatment of metals;
- FUNDP: physical chemistry of solid materials surfaces and interfaces, through development of interfacial materials and their characterization;
- CoRI: organic coating applications and property characterization.

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Results

Interaction between the different partners

Academics

VUB : Interfacial chemistry, organic film formation, surface analysis, corrosion and optical properties, etc.
ULB : atmospheric plasma deposition, surface analysis, etc.
FUDNP : Vacuum plasma deposition, interfacial chemistry, (in situ) surface analysis, etc.

Research valorisation →

Innovating deposition methods, innovating properties, new knowledge and understanding for future research

Knowledge & technology transfer ↕

Coating centre

CoRI : Applied research on coating, surface analysis.

Industrial valorisation ↓

Coating development
Support and link for industry

Expected results and/or products

- Understanding how the deposition method influences the interface between the metal oxide and organic species, and how it is reflected in the film formation characteristics;
- Understanding the type of interfacial bonding between the metal oxide and the organic molecule, and how to manipulate the distribution/coverage of these bonds;
- Understanding how the metal oxide and organic components need to interact to create multi-functional properties.

Contribution of the project in a context of support to innovation and transfer of knowledge

All information on these multi-phase systems is relevant for the industry. The fundamental approach will be directly applied to the industrial practice through the dedicated project structure where the knowledge transfer between the academia and the coating centre is a central pillar that will result in better product understanding and improvement. This project will contribute to the currently limited state of the art on the mixed nano-oxide/organic systems.

Follow-up Committee

Target users are from the metal producing and processing industry, and organic systems suppliers:

Bekaert Technology Center ■ Aleris Aluminium ■ R&D Umicore ■ OCAS-Arcelor Zelzate ■ Arcelor Research Industry Liège ■ Coil ■ Chemetall GmbH ■ Akzo Nobel Decorative Coatings ■ SigmaKalon ■ IWT-Vlaanderen.

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Horizontal evaluation method for the implementation of the construction products directive (HEMICPD)

Context

One of the objectives of the European Construction Products Directive (CPD) is to harmonize the technical specifications with regard to dangerous substances and construction materials. Construction products could emit or contain substances that have been defined as dangerous substances under Commission directives and national regulations. In the future construction products may only be placed on the market in the European Union if they accord with the harmonised technical specifications and bear the CE mark.

Project description

Objectives

The goal of this research project is to improve the flow of knowledge and information vis-à-vis normalisation activities in the domain of indoor air measurements, indoor product emission testing, labelling and certification by proposing an evaluation method and standardised assessment methods for a harmonised approach relating to emissions from building materials into indoor air for implementation in Belgium. This approach will comply with current harmonizing efforts ongoing on European level.

Methodology

To achieve this goal following methodological approach will be used:

- preparation and follow up of the current evolutions in European standardisation processes and dangerous substances by participation in the new technical committee TC 351 established in November 2005 by the European Committee for Standardization (CEN) and in EOTA working group PT9 “regulated substances”,
- phase 1: document all available information regarding CPD, construction products, dangerous substances and indoor air by means of state of the art reports which serve as the backbone for phase 2,
- phase 2: development, modification and comparison of test methods for use in laboratory and in situ,
- phase 3: translation of the results into a Belgian evaluation model for emission of dangerous substances from construction products into indoor air.

Partners

Activities

All three partners are complementary equipped regarding emission measurements. BBRI will execute building product emission testing in a µ-test chamber, VITO in a “medium-sized” (1 m^3) test chamber and ULg will perform building product emission tests in a “real size” (60 m^3) chamber. VITO is specialized in analysis methods for dangerous substances. ULg has great expertise in the field of odour measurements. Also in the domain of microbial resistance all three partners have complementary expertise and equipment.

Website project

www.bbri.be/go/hemicpd

Coordinator

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Results

Interaction between the different partners

To achieve this goal a task force between BBRI (construction research centre), ULg (university) and VITO (scientific institute) was established. The BBRI has a strong involvement in the needs of the construction sector by means of the different technical committees on national and international level and, on the other hand, its advisory service which gives about 20.000 advices per year to the building sector. By this task force the necessary expertise on construction products, standardisation, technical approvals and test & validation methods concerning dangerous substances and odour is consolidated.

Expected results and/or products

- State of the art report documenting all available information on standards, test methods/protocols, labels, dangerous substances, relevant building materials and available emission data for the determination of emissions from construction products into indoor air;
- Results (data sets) of experiments performed with complementary methods;
- Correlation between laboratory and in situ emission methods;
- Developed fast screening method for volatile organic compounds;
- Methodology for microbial resistance;
- Odour test for use in laboratory and in situ;
- Analysis method for semivolatile organic compounds;
- Test method including evaluation for the emissions of dangerous substances from construction products into indoor air;
- Website on which information will be made available.

Contribution of the project in a context of support to innovation and transfer of knowledge

This research project for implementation of the essential requirement “Hygiene, health and the environment” of the Construction Products Directive will besides its informative and sensitizing role also perform a supporting role in the development of new innovative low emission construction products. Furthermore this research project will lead to the development of new innovative test methods tailored to the specific needs of construction products.

Follow-up Committee

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Since the project aims to integrate all different actors in the construction sector, we have chosen to have a representation as broad as possible:

Council of European Producers of Materials for Construction (CEPMC) ■ FPS Health, Food Chain Security and Environment - Product Policy Service ■ European Organisation for Technical Approvals (EOTA) ■ WENK Sint-Lucas ■ BBRI-BUtgb ■ Vlaamse Huisvestingsmaatschappij (VHM) ■ BCCA-SECO ■ FPS Economy, SMEs, Self-employed and Energy - Division Competitiveness ■ IWT-Vlaanderen.

Low energy housing retrofit (LEHR)

Context

Buildings account for up to 35 percent of the total energy consumption in many European countries and housing accounts for the greatest part of this. Accordingly, renovating existing housing offers an enormous energy saving potential. A few exemplary renovation projects demonstrate that renovation can achieve five-fold and more energy savings while dramatically improving living quality. The success of these projects lies in their cost-effective combination of conservation measures to reduce energy demand.

Project description

Objectives

The project will begin by analyzing the building stock in order to identify building segments with the greatest multiplication and energy saving potential. In parallel, exemplary renovation projects achieving substantial primary energy savings while creating superior living quality will be analyzed. Important aspects are both energy performance and the owner's motivations behind the renovation. Drawing on this experience package of measures in combination with the most updated research front, new and innovative concepts and components will be developed. Insights from international collaboration (participation in IEA SHC Task 37 and observing European project E-RETROFIT-KIT) will be conveyed to target national end users in a deliberate strategy to increase the market penetration of advanced housing renovations.

Methodology

The following approach is taken by each partner towards their respective target group (PHP: project teams, UCL: housing owners, BBRI: building industry):

- collaborate on analyzing national housing statistics, defining possible renovation strategies and concluding which housing types and strategies should have priority at a national level,
- identify prototype projects as test cases to explore methodologies to accelerate market penetration,
- build an alliance and network to increase position and market impact,
- document design and performance of exemplary housing renovations, as well as impact on the environment, use of resources, urban infrastructure, health and quality of life,
- select key design parameters to be studied,

Partners

Activities

- Passiefhuis Platform vzw: founded in 2002, it's goals is to stimulate the Flemish passive house market, by playing an active role in developing and distributing relevant information towards all parties involved in the building process.
- UCL – Architecture et Climat: this research cell of the UCL aims since 1980 at the development of climatic and durable architecture, as well as energy efficiency.
- BBRI: this private research institute, founded in 1960, performs scientific and technical research for the benefit of and supplies technical information, assistance and consultancy to its members, and contributes in general to innovation and development in the construction sector.

Coordinator

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Expected results and/or products

- identify trends, concepts and approaches, which proved effective on an international level, and document these insights as summary design advice.

Interaction between the different partners

UCL will deliver a general publication showing housing owners successful, very low energy renovations. BBRI will provide a technical manual showing the building industry how successful, very low energy renovations can be achieved. PHP will provide publications and project leaflets informing planners and project developers of insights from exemplary project experiences. The partners will continuously review the proposed information.

General guidelines will mainly address an unaware public confronted with general questions about renovation and energy efficiency. These will be spread as:

- pdf document on the web sites of the partners and the regions, as well as mailed towards the target groups,
- a printed document during building fairs like Batibouw, Passiefhuis-Happening,
- a conference paper.

A technical manual will address the technical questions of the building professionals. It will be spread as:

- draft documents during meetings with the Follow-up Committee,
- pdf document on the web sites of all partners,
- an official printed document destined for the building industry ("technische voorlichting WTCB"),
- a conference paper.

The project information collects information about several demonstration projects. This will be spread as:

- printed project information leaflets during visits of the demonstration buildings and during meetings with new building teams,
- free of charge pdf reference documents on the web site of PHP (project database),
- IEA SHC annex 37 contribution,
- poster information on building fairs - conference paper (summary),
- annexes to the general guidelines and technical manual.

The collection of general guidelines, technical manual and project information will also be made available as an information booklet to be spread during a final workshop for architects and the building industry.

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Nanoceramics and their composites: processing by field assisted sintering technology (NACER)

Context

Ceramic materials with a fine nanostructure promise unusual combinations of properties. With respect to their mechanical properties one seeks an improved compromise between hardness and toughness. Coupled with their excellent chemical resistance, new applications will become possible where this combination of properties determines the choice of material required.

Project description

Objective

The scientific goal of the NACER project is to build on the experience and knowledge in the partnership to obtain the most advanced nanostructured ceramics and ceramic composites in close collaboration with interested Belgian industry.

Methodology

The process starts with the synthesis of powders with particles in the range 10 to 100 nm. To prepare objects in bulk from nanopowders, the powders will be formed into the desired shape using colloidal techniques based on suspensions. These lead to more homogeneous microstructures and also they will make for safer handling of the nanopowders. After shaping one needs to eliminate the pores between particles by heating to high temperatures in a process which is generically called sintering. A major challenge is to retain the nanostructure by minimising other high temperature processes competing with sintering such as grain growth, which tend to destroy the nanostructure. Field assisted sintering technology (FAST) also known as spark plasma sintering (SPS) or pulsed electric current sintering (PECS) is one of only a few techniques which have the potential to meet this challenge.

Materials envisaged to be investigated will be non-oxides (carbides, nitrides) as well as oxide nanoceramics and their composites.

Partners

Activities

- The ceramics research at the Department MTM, KULeuven, is organised within three main areas: synthesis and processing of ceramic materials and their composites, functional properties of ceramic materials, and modelling of processing and behaviour of ceramics.
- The INISMa (Institut Interuniversitaire des Silicates, Sols et Matériaux) is a non profit organisation created in 1973 by FPMs, UMH, IDEA and a group of industrial companies in order to carry out Research and Development and tests in the field of advanced materials, soils and environment.
- Sirris (Seraing): the driving lines for competence and service development derive from the department's function to support industrial innovation and competitiveness through the use of innovative materials and production technologies.

Interaction between the different partners

Sirris (previously CRIF/WTCM) has in Liege a plasma reactor to fabricate nano-powders in large quantities. As a result of a European project, a FAST apparatus has become available at the University of Leuven and advanced models have been developed for the temperature and current distributions during the process. Modelling the process to improve control is an important part of the technology. The INISMa in Mons is expert in specialised characterisation techniques of nanoceramics in powder or in bulk form. INISMa will be expected to deliver the necessary property data for modelling as well as to measure the functional properties of the ceramics and composites processed from the nanopowders.

The three partners are active in regional and European projects on nano-materials and nano-composites.

Results

Expected results and/or products

Targeted applications of this generic technology include wear resistant nano-structured materials for tools of various kinds, in particular cutting tools, tools for metal and glass processing; clinical bio-materials subject to wear; the development of multi-scale porous materials, materials for space mirrors based on silicon carbide.

Contribution of the project in a context of support to innovation and transfer of knowledge

The work plan includes case studies driven by the industrial members of the Follow-up Committee.

Follow-up Committee

Umicore ■ Bekaert ■ Ceratizit ■ AMOS ■ Eb.Consult ■ Ministère de la Région Wallonne (DGTRE) ■ IWT-Vlaanderen ■ Magotteaux ■ Halliburton ■ Diarotech

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Stretchable and washable electronics for embedding in textiles (SWEET)

Context

In “intelligent textile” products one of the aims is to embed electronic functions in garments, upholstery, etc. This is usually done using standard electronic devices in rigid packages like portable phones, mp3 players, etc. which are integrated by putting them in pockets, buttons, etc. The drawbacks are (1) the device cannot deform (e.g. stretch) in the same way textile does and (2) the device must be taken out of the garment during cleaning of the textile.

Project description

Objective

It is precisely the aim of the SWEET project (Stretchable and Washable Electronics for Embedding in Textiles) to perform work in the direction of highly integrated electronics in textile, which eliminates the above mentioned drawbacks. SWEET aims at the development of a technology platform for stretchable and washable electronic circuits and for embedding technologies of these circuits in textiles.

Methodology

The starting point for the developments was an embryonic technology for stretchable electronic circuits for medical (implantable) applications which was under development at one of the partners in the frame of the Flemish Community sponsored SBO-project “BioFlex”. To reach the goals of SWEET following logical sequence of activities is being carried out:

- technology developments are driven by 2 demonstrators, selected and specified at the beginning of the project;
- development of technology building blocks:
  - technology for stretchable electronic circuits, suitable for textile embedding,
  - development of electro-active polymers for use in sensor devices,
  - technology for surface modification to improve the polymer/polymer and polymer/metal adhesion,
  - technology for integration of the electronic substrate in the textile, including washability and typical textile handling tests,
  - technology for connection of the stretchable circuits with textronics elements like e.g. conducting fibres;
- design, production and testing of the demonstrators.

Partners

Project website
tfcg.elis.ugent.be/projects/sweet/

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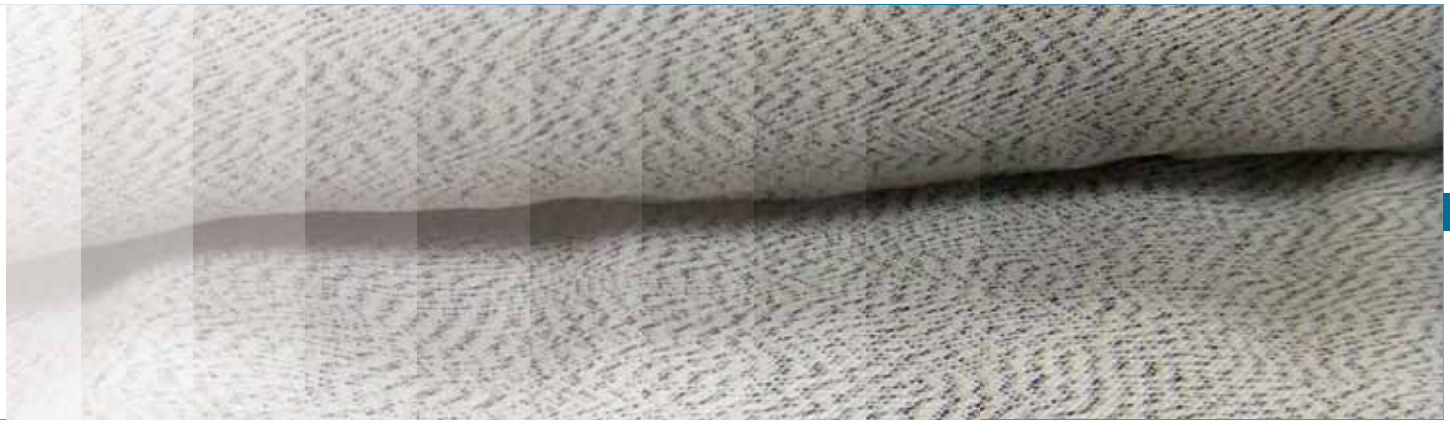

Results

Interaction between the different partners

The project is executed by a very well balanced consortium bringing together the various necessary competences:

- UGent/ELIS/TFCG (Prof. Jan Vanfleteren) is an electronic substrate and assembly process technology provider and is developing technology for stretchable electronic circuits;
- KULeuven/ESAT/MICAS (Prof. Bob Puers) is specialized in electronic system design and is responsible for the design and testing of the demonstrators;
- Centexbel (Ir. Jean Léonard and Dr. Dimitri Janssen) is a Collective Research Centre on textile and is responsible for development of the technology for integration of the stretchable electronic circuits in textiles;
- UCL/MAPR/PCPM (Prof. Arnaud Delcorte and Prof. Patrick Bertrand) is a polymer materials specialist and is responsible for the development of new electro-active polymers and for surface modification and characterization activities.

Expected results and/or products

- A universal intelligent textile building block on the base of MID (Moulded Interconnect Device) stretchable circuit technology;
- A fully functional user-defined demonstrator, including textronics elements and selected electro-active polymer sensors;
- A wide technology platform for washable and stretchable electronic circuits, including technologies for embedding in textiles, interconnection with textronics components, and electro-active polymer sensors.

Valorisation and dissemination activities

- A Follow-up committee has been installed which will intensively interact with the consortium. Composition of this committee can be found below;
- Both spin-off creation and partnership with an existing company are foreseen as possible valorisation strategies for the demonstrators and the technology platform;
- An IP platform will be built by filing patent applications on original findings;
- The consortium members will actively promote the SWEET technology in numerous other related projects where they are involved and where the SWEET technology can be of use. This will undoubtedly lead to additional short term applications or longer term follow-up R&D projects;
- Non-confidential material is/will be disseminated through different channels: public website (see below), a workshop at the end of the project, scientific publications, press releases, etc.

Follow-up Committee

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Companies with different profiles are involved in the SWEET Follow-up Committee:

- base materials suppliers,
- textile companies,
- electronics companies and system integrators from the medical/wellness/sports sector,
- end-users (medical sector).

The Follow-up Committee is composed as follows:

Alsico ■ Domo ■ Luxilon ■ Nomics S.A. ■ DTI S.A. ■ Verhaert ■ Dow Corning Corporation ■ NXP Semiconductors ■ Recticel ■ Agfa ■ Neurotech S.A. ■ Universitair Ziekenhuis Gent/kinderziekten ■ Universitair Ziekenhuis Gent/anesthesiologie ■ Universitair Ziekenhuis Gent/neurologie ■ Fibertex ■ IWT-Vlaanderen.

Towards an integrated acoustical and thermal approach of buildings (TIATAB)

Context

In a sustainable development of the built environment, thermal insulation, noise control and sound insulation are most important issues. Thermal concept decisions often have major acoustical consequences and vice versa. Thermal and acoustical regulations are in separate documents, unlinked to one another which makes it very difficult for the building industry. An optimized and integrated acoustical and thermal energetic approach, already in the preliminary project phase of products and buildings, is therefore highly desirable and will lead to numerous innovative systems, products and buildings.

Project description

Objectives

The project associates acousticians, thermal and ventilation specialists and informaticians in a consistent research group. Instead of letting the integration of the different technical specialties up to the designer, contractor or building element producers, the aim of the project is to the specialists in the research group make this exercise for them. Therefore each specialist needs to acquire a more profound knowledge of the other themes to see links and possible conflicts between the distinguished disciplines.

The project further wishes to enhance this integration process and to put this know how at the disposal of the building sector by integrating the detailed technical knowledge and requirements of the different specialties in a user friendly software tool.

Methodology

An important task of the project is the creation of important databases, linked to the software and containing the thermal and acoustical performance of materials and building elements. The information contained in these databases is - even independent of the software - extremely important for the building sector for tenders, renovation programs around the airports. Further more it stimulates industry to have their products and materials tested and to enhance their thermal and acoustical qualities.

The project wants to go even beyond the integrated design models towards virtual construction models: new developments in 3D-modelling based upon objects linked to an IFC-description (Industrial Foundation Classes) are in this context extremely important for the future. By this technology, acoustical and thermal calculation tools can be connected to architectural design programs such as REVIT, VECTORWORKS, ARCHICAD and others, making use of the data of the composing elements of a building (window, wall, door, ventilation grid,…). Each of these objects, as well as its connection with neighbouring objects, are completely documented in the program in IFC-objects. This evolution is important for the building element and material producing industry and the project considers this as part of the job to make industry aware of these evolutions.

In the next step, all developed tools are tested and improved while applying them to study-cases. With the acquired integrated knowledge of the different specialists in the research group and with the developed software tools, the research group wants to develop new “products”: integrated thermal and acoustical building directives, product

Partners

Activities

- BBRI (Department of Acoustics, building Physics and Equipment): this private research institute founded in 1960 performs scientific and technical research for the benefit of its members to which it supplies technical information, assistance and consultancy, and contributes in general to innovation and development in the construction sector;
- KULeuven (Laboratory of Acoustics and Thermal Physics): this laboratory conducts scientific research in acoustic and thermal fields;
- ULg-CEDIA is the acoustical division of the University of Liege.

Coordinator

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development directives for new products (e.g. sandwich panels, doors, etc.), possibilities for next generation integrated standards… And of course, the steps beyond the project will probably include innovation projects with the industry: combined knowledge is indeed a stimulating step towards industrial innovation.

Results

Expected results and/or products

Next to the most important result, that is to say the acquired integrated know how that is useful in the development of new products, building guidelines, standards, etc., we can enumerate the following direct results of the project:

- the creation of freely accessible databases on the internet that offer advantages as well as to the users of the database as for the industry that puts its data on the databases;
- the development of users friendly software containing all extensive, complex technical information and requirements allowing the non-specialist to make correct and optimized thermal and acoustical design decisions;
- the development of thermal and acoustical integrated and optimized building guidelines that will be published by the BBRI and explained in series of conferences. Through networking (e.g. by the technical committees and the Follow-up Committee), one can expect that these guidelines will be rapidly applied in the extensive subsidized, renovation programs around the airports and major traffic axes in our country;
- the development of integrated design guidelines for new products (e.g. improved sandwich panels, door constructions, ventilation grids, etc.);
- with a high probability, one can expect innovation projects with industry after the end of this project;
- the realization of integrated thermal-acoustical quality labels for buildings what should lead to better buildings;
- lectures (nationally and internationally), workshops and publications (printed and on the internet via the “Normen Antennes” Website) about the integrated approach and about the swift evolutions in the virtual building tools based on the IFC-approach;
- the obtained knowledge will help renovation subsidizing authorities to double the effect of their effort: get for the same money thermal and acoustical good renovations. We could help make this happen by good prescriptions in the requirements, with the above mentioned guidelines and to assist them in future actions;
- report to several Belgian and European standardisation committees and research groups about this new approach. The disposal of a working group of mixed acousticians and non-acoustic building physicists with good knowledge of each others discipline (far beyond the passive general knowledge we all have now), able to form the nucleus for a new integrated approach in standardisation, legislation, the development of guidelines for and the development of innovative products, building elements and construction.

Contribution of the project in a context of support to innovation and transfer of knowledge

The results of such a research are definitely interesting for the environment, for the occupiers of buildings and for the global building industry in Belgium, still one of the major thriving pillars of the national economy.

Follow-up Committee

The Follow-up Committee is composed of contractors, architects, consultants, producers of building materials and elements, public authorities:

Saint Gobain Glass ■ Wienerberger ■ ESTIA Entreprise ■ BANP ■ Sowaer Environnement ■ CDM ■ Glaverbel ■ Aminal ■ Vlaamse Maatschappij Sociaal Wonen ■ Reynaers Aluminium S.A. ■ Entreprises Générales EDK De Kempeneer ■ Blasco sprl ■ IWT-Vlaanderen ■ FPS Economy, SMEs, Self-employed and Energy.

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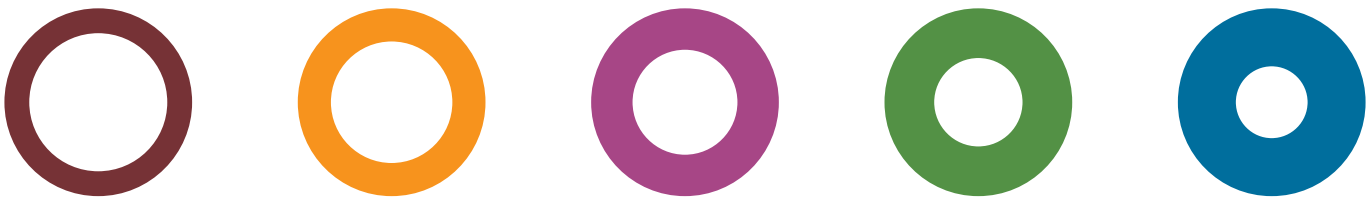

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