

## Application driven digitalized materials development renews Finnish Industry

*DIMECC Material research programs Hybrid Materials, DIMECC HYBRIDS and Breakthrough Steels and Applications, DIMECC BSA are renewing and digitalizing the manufacturing industry by tackling critical industrial research questions through modern material science and modelling based on concrete application needs. One of the key attributes in this industry-driven collaboration has been digital material research which has been systematically developed and implemented especially through the DIMECC Breakthrough Materials Doctoral School with its 38 Doctoral Theses. Intensive co-operation of over 60 companies and tens of research groups has produced a bunch of tremendous novel material solutions and created new multidisciplinary competence for the needs of multiple industries such as metal, mechanical engineering, cleantech, energy, processing and transportation. Key results of both programs were presented in the Final seminar May 16<sup>th</sup>, 2017 at Aalto University, Espoo, Finland.*

DIMECC BSA and DIMECC HYBRICS have together implemented unique industry-driven research co-operation where top-level scientific research and practical needs of multiple industrial partners are combined effectively. The highly cross-technological consortia involved large companies and SMEs representing several existing value chains and building new ones. The research partners included top Finnish research groups, selected high level international partners and young talents of the DIMECC Breakthrough Materials Doctoral School. This unique element built inside both programs has been running 38 inter-linked doctoral projects solving together the critical research questions set by the industry. One key focus area has been digital materials development (or Integrated Computational Materials Engineering, ICME), which has been systematically developed to tackle these specific research challenges - combining experimental work and modelling in all relevant scales from microstructures to manufacturing, product performance and lifecycle management.

“If we want to raise the level of science in Finland, companies are needed to be involved which might be surprising for someone. However, according to international analysis, the amount of citations of scientific articles are more than double when authors from both companies and academia are present. Often citations act as an assessment for the level of the publication. Field-Weighted Citation Index is in highly developed countries 2,5 times higher for articles co-authored with industry people compared to publications made by an academic researcher alone. Therefore, the DIMECC innovation ecosystem through which the companies and academic researchers are brought to co-operate for research, development and innovations, is proven to raise the level of science”, comments the CEO of DIMECC Oy **Harri Kulmala**.

“Digitalized materials development has shown the possibility to cut the product development time even to a half and improve the predictability and reliability of materials and components in challenging environments. We have implemented the concept in practice to serve real problem solving in our industry-driven projects. As a result, a new multi-disciplinary knowledge platform and a set of novel, competitive, sustainable and energy efficiency material solutions have been developed to boost Finnish export industry”, says DIMECC’s program manager **Markku Heino** from Spinverse.

Big amount of large and middle size companies, providers and users of materials regarding multiple application fields have been involved in the research collaboration. The intensive joint work of key players has also guaranteed rapid transfer of the research results to industry supporting new product and business development. Starting point of our research has been understanding the needs and challenges of selected applications. The approach to tackle these have included e.g. experimental development of new advanced materials, their manufacturing and processing techniques, utilizing so called multi-scale modelling and

simulation, multidimensional characterizing and creating new application concepts. The common goal has been to achieve novel properties and property combinations to meet the needs of demanding industrial applications, and build novel competitive solutions in a sustainable and cost-efficient way for application fields like mechanical engineering, construction, renewable energy, transportation, electronics, bioeconomy, process and chemical industry.

### **BSA – Breakthroughs in steels from basic phenomena to novel applications**

The wider use of lifecycle-efficient special steels and cast materials have been promoted by developing their usability, processability, long-term properties, design rules and methods for a variety of applications. The work has focused both on modern high-strength steels and stainless steels. This pioneer work has shown the high potential of the advanced high-strength steels in e.g. ship building and construction and created a strong scientific base for the redefining the standards and design rules needed. For example, by using novel high-strength steels the weight of big cruising ships could be reduced by 25 %. Development of new material concepts targets to achieve growth in the industry through higher value-added products segment and decrease the dependence from expensive and limited raw materials. The core element for the overall goal has been the deep understanding of basic phenomena and the development and practical implementation of modern experimental research methods and modelling tools.

“In the BSA program SSAB has developed several novel ultra-high-strength structural steels based on its own direct quenching technology together with end-users and research institutes. Thanks to the intensive co-operation it has been possible to realize rapid product development ranging from novel steels to the production of end-products by our partners. The equipment manufacturers have fluently implemented the fresh results of SSAB into development of their own products and applications”, says Product development manager **Pertti Mikkonen** from SSAB Europe Oy.

### **Resource efficiency and specific properties with hybrid materials**

Hybrid materials target to unique property combinations by combining different materials (metals, ceramics, polymers) or elements to one specific material or to relevant structures. DIMECC HYBRIDS program has systematically built new multidisciplinary competence network to implement common, strategic, ambitious research agenda. The consortium includes material manufacturers (metals, plastics, composites, nano/special materials), experts of design, measurement, instrumentation, production techniques and coating technologies and a large number of manufacturers of final products from various value chains. Goal of the program has been to improve the competitiveness of Finnish industry through value-added and knowledge-intensive material solutions and by building deep multidisciplinary competence. As a result, e.g. specific coatings and related methods offering features like non-sticking, wear and corrosion resistance have been developed. New energy-efficient solutions to decrease friction for moving machine components, advanced noise damping structures and novel sensing solutions serve as further examples.

“DIMECC HYBRIDS program has created excellent possibility to build real co-operation between research institutes, small companies and industry. International level material research fulfills well the needs of Valmet and serves naturally our strategical long-term development”, comments Director, R&D **Heikki Kettunen** from Valmet Oyj.

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**Program of the Final seminar:**

[https://www.dimecc.com/wp-content/uploads/2017/03/20170516\\_DIMECC-BSA-and-HYBRIDS-Final-Seminar\\_program.pdf](https://www.dimecc.com/wp-content/uploads/2017/03/20170516_DIMECC-BSA-and-HYBRIDS-Final-Seminar_program.pdf)

**More information about the results of the programs:**

[DIMECC BSA](#)

[DIMECC HYBRIDS](#)

[DIMECC Breakthrough Materials Doctoral School](#)

**Final publications:**

[DIMECC BSA Final publication](#)

[DIMECC HYBRIDS Final publication](#)

**Selected result highlights in English:**

<http://hightech.dimecc.com/search/bsa>

<http://hightech.dimecc.com/search/hybrids>