

**Åbo Akademi University  
& University of Helsinki  
Center for Functional Materials  
FUNMAT**

**Annual Report 2009**

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# FunMat Annual Report 2009

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Foreword

The successful collaboration in material science between Åbo Akademi University and University of Turku lead in 1994 to the establishment of the Centre of Expertise in Materials Research, financed by Ministry of Interior. Later, the efforts were concentrated on Materials Surface Techniques and a commercial instrument center Top Analytica Ltd was established. The overall strategy for establishing the Center for Functional Materials (FunMat) was based on market surveys made by Turku Science Park and Foundation for New Technology. The collaboration was initiated through the establishment of Knowledge Network of Printed Media in 2005 with Åbo Akademi University, University of Turku, Top Analytica Ltd., Forest Pilot Center Ltd., Hansaprint Ltd, CIBA Ltd. and Turku Science Park Ltd. as partners. In 2006 the national responsibility for printed intelligence at the national Centre of Expertise program, Forest Industry Future was awarded to Turku Science Park Ltd. Expertise Network for Printed Communication.

In 2005 Åbo Akademi University launched an internal competition for research groups to receive extra funding for three years, set into disposal by the Foundation for Åbo Akademi University to “*create strong research environments of international standing*”. Out of the 28 proposals 14 were in 2005 selected for further evaluation by an international committee, consisting of: Professor Bengt Ankarloo and Professor Ole Elgström, Lund University, Professor Gunnar Svedberg, STFI-Packforsk, Professor Morten Søndergaard, University of Copenhagen, Professor Lars Bäckman, Karolinska Institutet and Professor Udo Zanders, University of Economy, Stockholm. The Functional Materials Center (FunMat) for Printable Electro-, Magnetic-, Optical-, Chemical-, and Biofunctionalities was in 2005 selected as one of the four Åbo Akademi Centers of Excellence for the period 2006-2008. Moreover, FunMat Center received pilot project support from the Ministry of Education, starting 2007.

An option was originally set for maintained or altered funding for 2009 and an option for extension to 2010 after an additional evaluation. In 2008 Professor Lars Bäckman, Karolinska Institutet , Professor Ole Elgström, Lund University, professor Bjørn Tore Gjertsen, University of Bergen and Professor Gunnar Svedberg, STFI-Packforsk, conducted the planned evaluation. The conclusion concerning FunMat was: “It is no doubt that the research performed within the fields covered by FunMat Center will continue to have a leading position in Finland and also to be a highly acknowledged actor internationally. Funding should definitely continue but the overall aim to integrate and coordinate the research must be heavily emphasized”. Surprisingly, Åbo Akademi University decided instead to reduce the funding for 2009 and not to provide any optional funding for 2010!

The principal aim of the Åbo Akademi University Center of Excellence action was to promote consolidation of the winning research networks to be competitive in the Academy of Finland application for national Center of Excellence status. The requirements for such status were quite demanding. In the overall judgment, the expert panel had to rank the successful candidates, within their project field among the top 5% in the world! Out of the 113 preliminary applications, 44 research teams were asked to provide a full application. Out of these, 28 groups passed the 5% demand level. The finalists were then evaluated on societal relevance of their projects. Only 18 passed this final test and were elected as national Centers of Excellence for the period, 2008-2013.

The proposal of the Center for Functional Materials was evaluated by Professor Dieter Rehder, University of Hamburg, Professor Paul Gateholm Chalmers University of Technology and Professor Harald Grossmann, Technical University of Dresden. As a result of the evaluation, FunMat was the only

one of the four ÅAU teams winning the Center of Excellence status at the Academy of Finland! One important reason for this success was probably the integration of the research groups in supporting national graduate schools for researchers training, in particular Graduate School of Materials Research (GSMR) of which most partners hold a share.

The Academy of Finland nominated Professor Ann-Christine Albertsson, Royal Institute of Technology, Stockholm and Professor Ananth Dodabalapur, University of Texas at Austin as experts in the International Scientific Advisory board. After reviewing the research activities at the first Advisory Board meeting in September 2008, the concluding remarks were, "The overall scope and composition of the CoE is very good. The area of emphasis – Functional Materials – is one which is of considerable scientific as well as technological importance. The composition of the FunMat team is also very good, with the leading scientists in this area in Finland participating. Finally, the leadership of Prof. Rosenholm is dynamic".

This report describes the organization and personnel at the Academy of Finland FunMat Center of Excellence in 2009. The Yearbooks 2006-2007, 2008 and 2009 provide, together with an additional statistical report the substance presented at the half-term evaluation by the International Scientific Advisory Board in May 2010. All projects being active in terms of publication output are included as well as the (BSc, MSc, PhL, PhD) theses and publications appeared in 2009 to printing date. The projects do not fully match with those listed in the application, since a number of them have ended and a large number of new projects have been initiated since then. For additional information on the activities, the reader is referred to the homepage: [www.funmat.fi](http://www.funmat.fi) with links to each partner. It is my sincere hope that this report convinces the reader that the activities have been well focused and exceptionally successful.

Åbo, April 2010

Jarl B. Rosenholm  
Professor, Chairman

## 1. Introduction

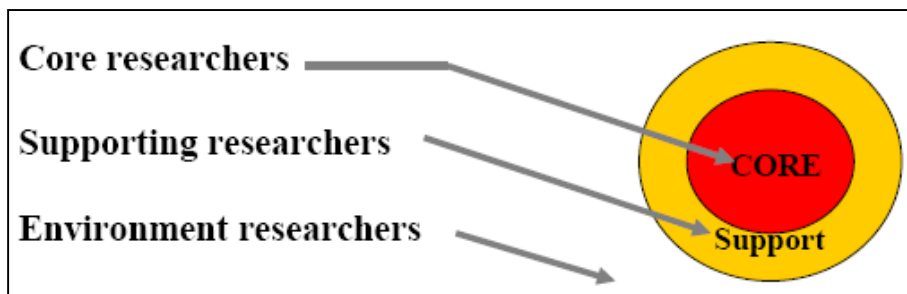
In the application the FunMat activities were illustrated as an unbroken value chain including the following headings:

1. **Materials**, including synthesis and physico-chemical modification
2. **Functionalization** by printing, coatings or films
3. **Characterization and modeling** of precursor materials and structures
4. **Utilization** by demonstration of performance of functionalized assembled structures, papers and boards

However, since all stages are inter-related the project phases may be better understood as both, forward characterization cycles and feedback modeling cycles. The schematic diagram strives at demonstrating the dynamic nature of the research and the continuous need for multiple competences.



It is self-evident that only a fraction of the research can be focused on the core target areas to which the FunMat financed researchers contribute. Instead, in order to develop new materials and processing techniques a substantial fraction of the research is only indirectly coupled to those goals. Such supportive research, provide merely the basic knowledge for the FunMat oriented projects. Through researchers at graduate schools, e.g. Graduate School of Materials Research the network could be expanded to a wider competence in material science.



Environment research provides basic training in general surface and colloid (nano) chemistry, thermodynamics, physics, etc. needed to design models, which optimally are successful in predicting the material properties and processes of importance for FunMat goals.

In order to advance the FunMat goals, all core activities have been coordinated within five working groups by experienced researchers. The working groups are:

1. *Synthesis of Functional Materials*, coordinated by MSc Petri Pulkkinen
2. *Printed Power Supplies*, coordinated by Ass.Prof. Mika Lindén
3. *Magnetic Sensors*, coordinated by PhD Himadri Majumdar
4. *Electrochromic Displays*, coordinated by MSc Carl-Johan Wikman
5. *Sensor Arrays*, coordinated by PhD Petri Ihalainen
6. *Printing Methods and Equipments*, coordinated by PhD Tapio Mäkelä

However, in order to emphasize the projects listed in the application, the outcome of the research will be presented under these headings, together with relevant publications. Since the topic areas have developed further from the heading and aims documented in the application, each project report is introduced with a modified heading and by a short summary written by the coordinators. The original project topics were:

Project I: **Synthesis of inorganic particulate meso-structures and core/shell capsules**, *project leaders Professor Jarl B. Rosenholm and Ass.Prof. Mika Lindén*

Project II: **Synthesis of organic particulate meso-structures and core/shell capsules**, *project leader Carl-Eric Wilén*

Project III: **New generation of dispersing agents**, *project leader Professor Heikki Tenhu*

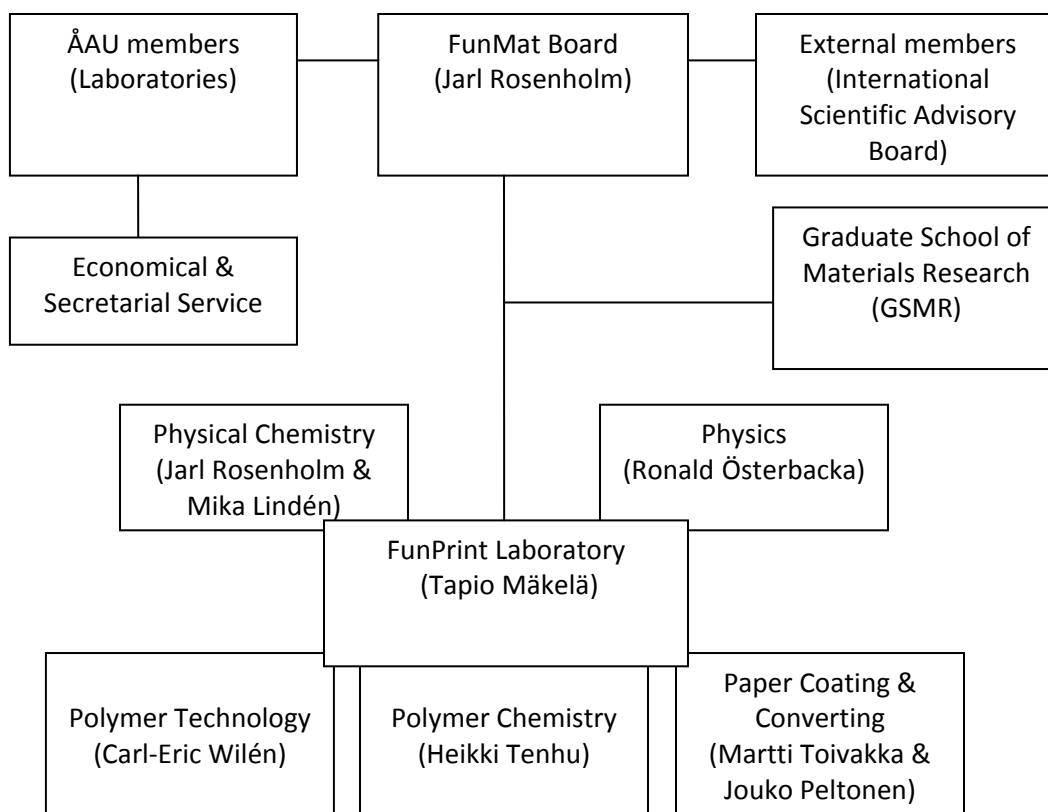
Project IV: **Substrate activity and compability for functional materials**, *project leaders Professor Martti Toivakka and Professor Jouko Peltonen*

Project V: **Electro-optical and magnetic properties of functional materials**, *project leader Professor Ronald Österbacka*

Project 6: **Functional Materials Printing (FunPrint) Center**, *project leader PhD Tapio Mäkelä*

Only refereed publications for the years 2009-2010 are listed. Note that the 2008-09 publications are listed in Annual Report 2008. For additional information on the activities, the reader is referred to the homepage: [www.funmat.fi](http://www.funmat.fi) with links to each partner.

## 2. Organization of the Functional Materials (FunMat) Centre



### Executive Board

#### *ÅAU members:*

Professor Jarl Rosenholm (Chairman)  
Professor Ronald Österbacka (Vice chairman)  
Professor Carl-Eric Wilén  
Professor Heikki Tenhu  
Professor Martti Toivakka  
Professor Jouko Peltonen  
Ass.prof. Mika Lindén  
FunPrint Lab. manager Tapio Mäkelä

#### *External member:*

Mining Councillor Tor Bergman

#### *International Scientific Advisory Board:*

Professor Ananth Dodabalapur, University of Texas at Austin  
Professor Ann-Christine Albertsson, the Royal Institute of Technology