Swedish Foundation for Strategic Research

9 September 2011

The Swedish Foundation for Strategic Research calls for proposals for research group grants for Materials Science research

The Foundation calls for proposals for research group grants for research in the areas of *Functional coatings and surfaces* and *Lightweight materials* within a maximum framework of SEK 150 million. The research group grants are intended to be in the range of SEK 4-7 million per annum over a period of five years. The funding for the last two years is dependent on the outcome of a mid-term evaluation. These grants will finance research of the highest international class and with strategic relevance for present and future industry in Sweden.

1. Importance of materials

The field of materials is of great importance for Sweden and annual export revenues from material-based industry amount to hundreds of billions of kronor. Swedish companies such as Sandvik, ABB, Volvo, Autoliv, SKF, SSAB, Kockums, SAAB, Volvo Aero, DIAB, SAPA, Finnveden, TetraPak, Stora Enso and others have been extremely successful on the global market and sometimes market leaders in their segments. Swedish universities and research institutes fulfil an important function by turning out engineers and scientists whose qualifications in the field of materials science suit the needs of the industry. The strategic relevance of the research can be strengthened by means of closer contacts between the different sectors.

In most areas of technology – production engineering, electronics, structural engineering, energy technology, transport and communications technology, etc. – it is generally accepted today that it is the availability of materials and the properties of the existing materials that set the practical limits for development. Continued technological progress is demanding increasingly high-performance materials, materials with special or extreme property profiles, materials for complex functional demands, and so on. To meet these demands, cutting-edge materials science research should span multiple disciplines. Swedish materials research today is of a very high scientific class, as demonstrated, for example, by evaluations from SSF and the Swedish Research Council.

2. Initiatives and priorities

Theory, modelling and experimentation should be integrated in all proposed projects. New, innovative ideas are welcomed, but applicants must also consider the prospects for upscaling to industrial application. Nanotechnology is a natural component in all fields and has not been identified as a special initiative area.

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3. Examples of prioritized areas of technology

3.1 Functional coatings and surfaces

Functional coatings are coatings or surfaces created to provide increased functionality, either through the coating's inherent properties or through its properties in combination with a substrate and/or the surrounding environment. The thickness of the coatings can typically vary from a few nanometres to about a hundred micrometres. The coatings may have a direct function, which means that the properties in the unused state ("as coated") are those sought after. The coatings may also be intended to be used in an application that exposes them to atomic, topographical or microstructural change. They may further be coatings that affect the surrounding environment and/or substrate rather than undergoing appreciable change themselves. It is of great importance that the functionality of the coatings is studied in their planned application environments, or in environments that simulate these. Examples of production technologies are: wet-chemical methods, CVD, PVD, plasma spraying, electron beam deposition, thermal spraying, nanoimprint methods, reactive ion etching, molecular self-organization and enzyme-catalyzed synthesis, or a combination of the above techniques.

Great innovative advances are often made when surprising properties are achieved by a combination of the properties of individual components. It may therefore be worthwhile investigating whether multiple properties can be achieved in one and the same surface coating.

3.1.1 Surfaces requiring functionality in demanding environments – Durable surfaces

Durable coatings on tools and wear parts are subjected to extreme stress. Purely tribological applications may be included here, where properties such as friction and abrasion resistance are in focus. Other applications involve major structural changes in the coating caused by phase transformations and diffusion phenomena that occur at high temperatures and pressures in combination with wear. Another challenge is to develop coating materials, or alloy combinations of coating materials, which combine properties such as hardness and toughness. There is a long tradition in Sweden of development of tool materials of both tungsten carbide and advanced materials such as diamond and cubic boron nitride. The field has a strong Swedish industrial branch with world-leading producers, and it is therefore of great importance to continue pursuing development at the scientific front line.

New electrical contact materials provide a better way of achieving stable contact resistance with high resistance to corrosion and wear as well as higher thermal stability than traditional metallic contact materials.

3.1.2. Surfaces requiring functionality in demanding environments – Chemicals

Chemically aggressive environments impose high demands on the design of suitable coating materials. This category includes surfaces in contact with lubricating oils in gearboxes, which is of importance for the automotive industry, for example. Corrosion-resistant coatings enhance the quality of structural materials for a variety of applications.

The development of tomorrow's catalytic converters and their carrier materials, as well as membrane processes in the chemical process industry, are examples of applications in which resistance to aggressive chemicals is one of the most important design parameters for a surface.

3.1.3 Surfaces requiring functionality in demanding environments – High temperatures

Materials that are resistant to high temperatures are of interest for coatings on parts of jet engines, furnaces, incinerators, electric switches, etc. Surfaces with a combination of properties, such as reduced friction of mechanical parts, and surfaces that can withstand high temperatures and are stable in chemically aggressive environments are also important.

3.1.4 Surfaces requiring direct functionality - Biocompatibility

Design of material surfaces with special structures for biocompatibility fits well in with Swedish materials research. Surfaces can be made biocompatible - or bioactive - by e.g. grafting, via physical adsorption of active components, or by topographical modification. By means of grafting and enzyme-catalyzed surface modification reactions, both organic and inorganic surfaces can be given suitable bioactive properties, which can further be combined with sensory properties. In addition to promoting functions such as biocompatibility, surface treatment can also enhance other properties such as abrasion resistance.

Many processes and material modifications pertain to the biomedical field, specifically biosensors or biomedical systems. Medical implants can be made biocompatible or antimicrobial by means of suitable surface treatment. With a progressively ageing population, there is a great need for development of implants for e.g. knee and hip joints with a high level of quality for the wearer. Different combinations of materials and surface treatments must be compatible in the sense that leaching of harmful metal ions is avoided. Other applications where biocompatible surfaces are of importance include e.g. systems for air and water purification. All of these functional biocompatible surfaces are subject to environmental and safety-related requirements.

3.2 Lightweight materials

Products that save weight and space are of central importance today. Both completely new materials and existing materials in new applications are important. Lightweight materials and structures contribute to better resource efficiency via reduced weight and reduced consumption of materials and higher energy efficiency, at the same time as polluting emissions are reduced in all sectors of industry and transport. Lightweight structures are beneficial in health care and sports as well.

There is a long tradition in Sweden of developing metallic structural materials. High-strength steels are a strong Swedish industrial segment where we have several world-leading material producers who can, through continued development and new applications, boost development in for example the transport sector. Sweden has few major producers of synthetic polymers and carbon fibre composites, but the use of these materials is increasing and new applications are being found all the time. Polymers are often of great importance in complex structures.

3.2.1 Polymer materials and composites

The trend is towards combining different structural components so that the range of use is further expanded. One line of development may be towards bioinspired, multifunctional structures in which functional gradients in material composition are integrated with geometric shape and controlled porosity. General areas are: nanodispersed materials, composites with controlled porosity and high-strength nano-fibres in combination with hierarchically organized structures, plus improvement of existing materials by e.g. the use of nanofibres or particles in the matrix. Specific functionalities can be achieved by means of material systems with controlled structures at the macro-, micro- or nano-level.

Production of new polymer materials, mixtures and foams are of interest. New design criteria, surface treatment, compatibility and material characterization, and not least long-term properties, need to be developed.

Polymers are often used to create flexible materials. New or improved applications can be obtained by integration with nanotechnology in e.g. non-woven and cellulose fibre-based materials. Interest is expected to increase in flexible materials for example diagnostics and integrated in concepts for sensors or other functional components.

3.2.2 Materials for lightweight structures

Innovative solutions based on metallic lightweight materials, metal foam, composites, polymers etc. are included in this category. A major challenge is producing structured composite materials, which is a key to substantially expanding the range of properties, thereby increasing the usefulness of the composite materials.

Sweden has few major producers of carbon fibre and composite materials, but their application is a major Swedish industrial sector. In the aerospace industry, a technological shift has made carbon fibre composites, both with and without metal stacks, the most important material. The rest of the transport sector will increase the use of such materials in the future. This entails new challenges when it comes to forming and machining, which is an important impetus for the development of new cutting tools.

Production technology, robust compounding, forming, machining and recycling aspects, including health aspects of production and machining, are central to this field. Design, design criteria and the property optimization are prioritized development activities. Key technologies are joining, machining, surface coatings and various hardening mechanisms. It must be possible to join together new materials, individually or in combination with other materials, in products and useful structures, for example lightweight bulk material with a high-strength external load-bearing shell.

4. Applications

The application process is carried out in one step with a complete application. Applications should include a detailed description of the research project and a preliminary plan for future exploitation and describe the applicant’s qualifications. Applications should also include a clear account of the strategic importance of the research project for Swedish industry.

Applications are submitted via the Foundation's application portal at http://apply.stratresearch.se, which is open between 1 October and 21 December, 2011. Please log into the portal in good time before the application deadline in order to get a complete picture of all data required for application.

5. Eligibility

Applications are submitted by one main applicant, who must be a prominent researcher affiliated to a university or research institute. If the main applicant is active at a research institute, at least one of the co-applicants must be employed at a university. Each applicant may be represented in no more than one application as a main applicant and no more than one application as a co-applicant in this call. The number of co-applicants must be in reasonable proportion to the applied-for amount, and no more than 50% of the grant may be used for the main applicant's and the co-applicants' salaries and cover no more than 50% of each applicant's/co-applicant's salary.

Please note that principal investigators from ongoing five year SSF-projects from the materials sciences call 2008 (Rambidrag Material 2008) may not apply as main applicants in this call.

6. Evaluation process

Applications will be evaluated by an evaluation committee consisting of researchers mainly from Swedish universities, institutes and companies. A first selection will be made in which the applications are judged solely with respect to strategic relevance and whether they conform to the specifications of the call for proposals. The selected applications will then be reviewed by a panel of international scientific experts with respect to their scientific quality. The result of this scientific review and the strategic value of the applications will then be weighed together by the evaluation committee to arrive at a final proposal to be considered by SSF's Governing Board.

6.1 Ranking criteria

The purpose of Swedish Foundation for Strategic Research is to support research for the purpose of strengthening Sweden's future competitiveness. Among research funding bodies, SSF occupies a position between the Swedish Research Council and Swedish Agency for Innovation Systems (VINNOVA), as illustrated in the diagram below. The practical definition of strategic relevance, which will be used to rank applications, is that the research should have a clear vision of exploitation in Sweden within a time span of 5–15 years after completion of a project. In addition, applications that are judged capable of making a great contribution to Sweden's future competitiveness will be ranked higher than those judged to make a smaller contribution.

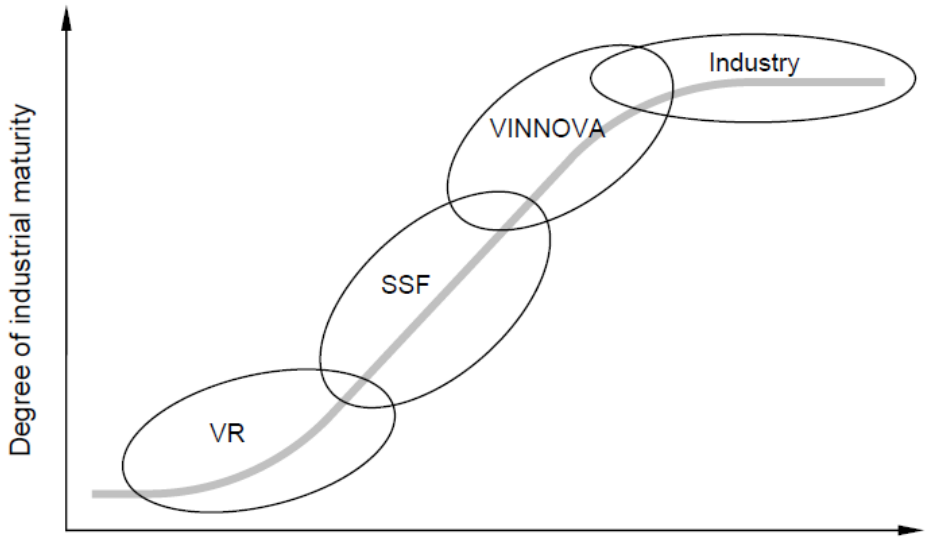

Figure 1. Positioning of Swedish funding bodies.

The applications will be evaluated using the following criteria:

• the scientific quality of the project and the qualifications of the applicants,

• strategic relevance for Sweden,

• conformity to the scope as outlined above.

It is vital that application give a clear picture of available resources and show that the proposed constellation of researchers will be effective.

The Foundation makes no demands on co-funding of the projects by participating industrial partners, and no such support letters may be appended to the application.

6.2 Timetable

The application deadline is **2:00 pm, 21 December 2011**.

The decision of the Governing Board is expected in June 2012.

Note that the SSF follows the principle of public access to official records. For this reason, do not send material that may not become public at present, e.g. anything that could prevent possible patenting.

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