

Examples of material solutions

Fracture-tough ceramic composite coatings with nanostructures

VTT utilises nanotechnology in ceramic coatings. VTT has developed in an international co-operation thermally sprayed nanostructured ceramic composite coatings whose fracture toughness has been found to be up to twice that of traditional ceramic coatings. The new protective coating is particularly suitable for application where the coating must have good temperature, wear and corrosion resistance.

The developed ceramic composite coatings offer new uses in applications that require good chemical and heat resistance combined with good wear resistance.

Anti-fouling sol-gel coatings

VTT develops and studies multifunctional and nanostructured hybrid coatings applying the sol-gel technique. Sol-gel coatings are suitable for a wide range of surfaces, e.g. metallic, plastic, glass, ceramic, wood and wood fibre products, and they can be applied on surfaces in the process industry as well as the living environment. The properties achieved using sol-gel coatings include anti-fouling and improved cleanability, abrasion and scratch resistance, corrosion protection, barrier properties and moisture control, modification of surface free energy, photocatalytic and antimicrobial properties.

Sensors from optical fibres

Optical fibre has been integrated with material in a variety of VTT research projects using coating technologies. The objective has been to create various coating solutions with sensing properties. Temperature monitoring has been developed as part of the protective coating for use in demanding environments with high temperatures. Wear has been monitored by detecting the thinning of the coating during use. This helps to avoid uncontrolled wearing out of the coating and facilitates the re-coating of the component.

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Innovative material solutions



Competitive properties using
advanced materials

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Competitive properties using advanced materials

New material solutions enable unique competitiveness through, for instance, enhanced efficiency, resistance to extreme conditions, friction behaviour and even the material's active functionality. Decorative properties can also be given a new look using the latest in material technology.

Advanced materials

New materials can be used to introduce new properties to the product, such as improved toughness, wear resistance, corrosion resistance, high temperature resistance, friction behaviour, self-lubrication, anti-fouling, electrical or thermal conductivity and insulating capacity.

Functionality is increasingly required from materials. Active functionality may mean, for example, wear-, temperature- or pressure-sensing material solutions, vibration control, constant deformation or even self-healing.

Nanotechnology is visible in various perspectives in material development. Nanostructures make it possible to have an effect on the material's properties, such as increasing fracture toughness, introducing surface anti-fouling, developing new light structures or controlling electrical and thermal conductivity. VTT is active also in matters pertaining to the safety of nanotechnology.

Applied utilisation of various technologies, such as biotechnology and more traditional material technology, offers completely new opportunities in the development of advanced material solutions.

Material customisation

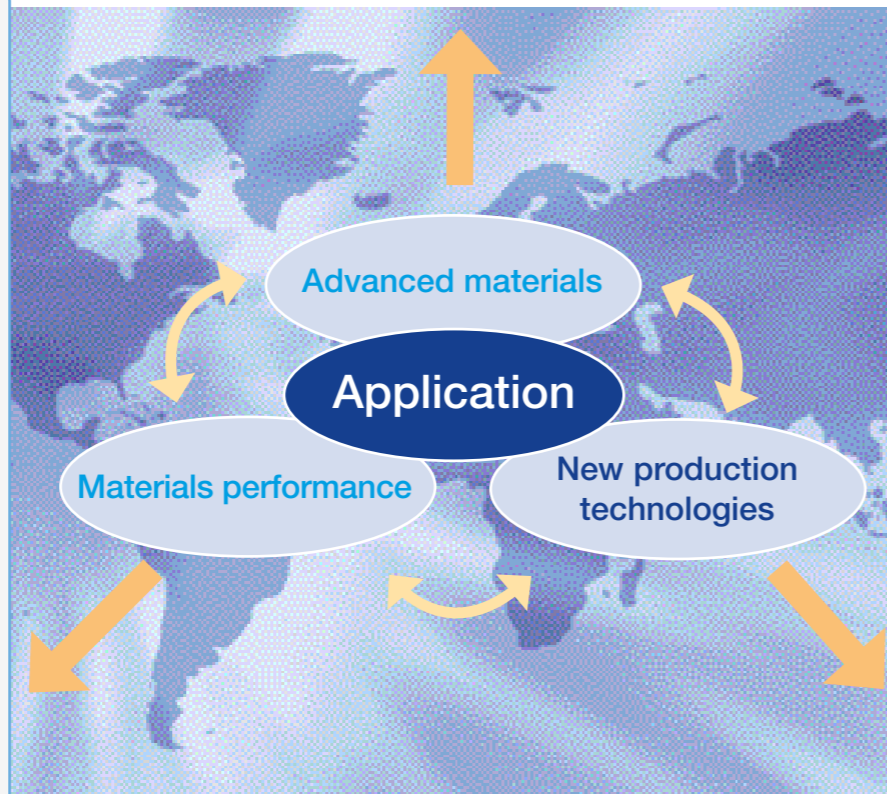
- Alloys and intermetallic compounds
- Ceramic structures
- Composite structures
- Polymeric materials

MATERIALS PERFORMANCE

Operating conditions are crucial for the material performance, as they have an effect on the material's properties and functionality as well as failure mechanisms (and service life). The material's surface properties often determine the entire product's performance and functionality. VTT has versatile know-how concerning the interaction between materials and their environments in a variety of solutions in high temperatures, environments exposed to corrosion and wear, lubricated and non-lubricated applications, under static as well as dynamic loads. Our usability estimates are based on practical experience, experimental research and applicable material modelling and expertise in damage mechanisms.

Versatile research preparedness

- Characterisation of material properties
- Experimental research in operating conditions
- Failure analysis
- Modelling and simulation



NEW PRODUCTION TECHNOLOGIES

The applicability of new materials depends on their manufacturability. Certain materials can only be produced with specific special techniques, and the application of such technologies to a certain purpose or component is often a challenging task. VTT's competence in manufacturing technologies covers not only material technological understanding, but also material availability, manufacturability, reparability, cost efficiency, recyclability and safety aspects.

Production of powders

- Mechanical alloying
- Agglomeration
- Gas atomisation
- Chemical synthesis

Coating techniques

- Thermal spray
- Laser
- Sol-gel
- Metallising
- PVD

Production of components

- SHS
- HIP
- MIM
- Casting

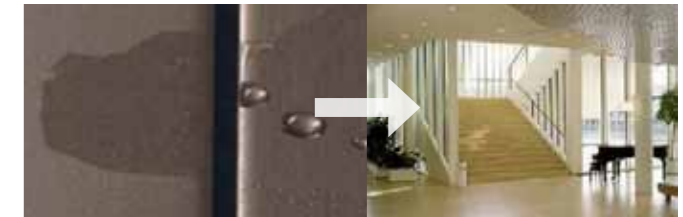
Others

- Laser machining
- Micromachining
- Welding and joining

Modelling and simulation



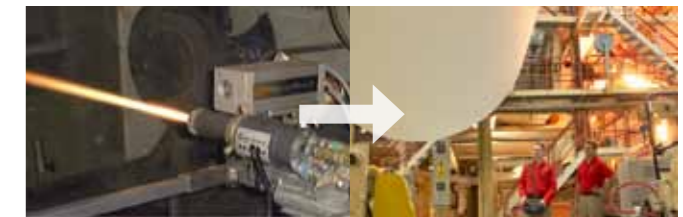
Shape-changing material → Wind power station



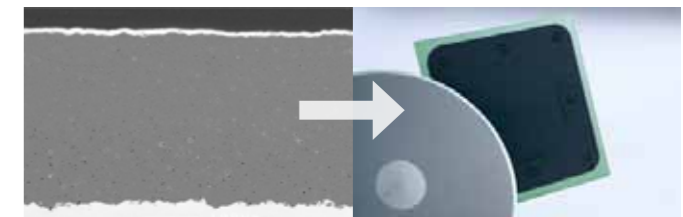
Anti-fouling properties → Building surfaces



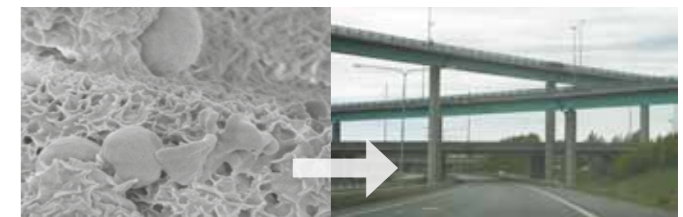
SHS → Wear resistant components



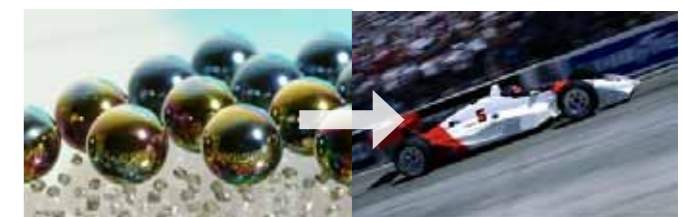
Corrosion and wear resistance → Paper mill



Ceramic coating → Fuel cell



Cementitious → Durable concrete structures



Low friction (DLC) → Formula

Design process

