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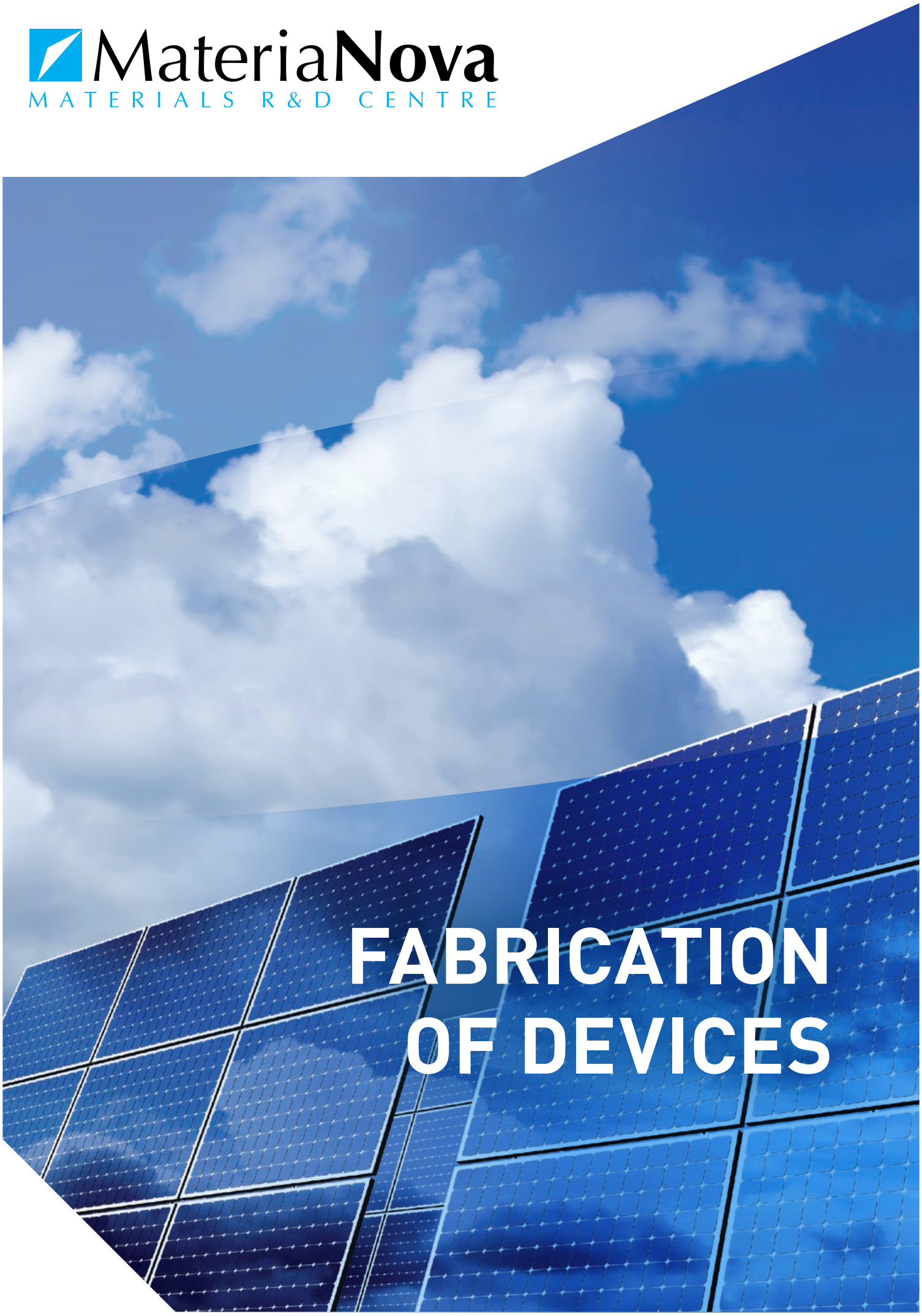
MATERIALS R&D CENTRE



FABRICATION OF DEVICES

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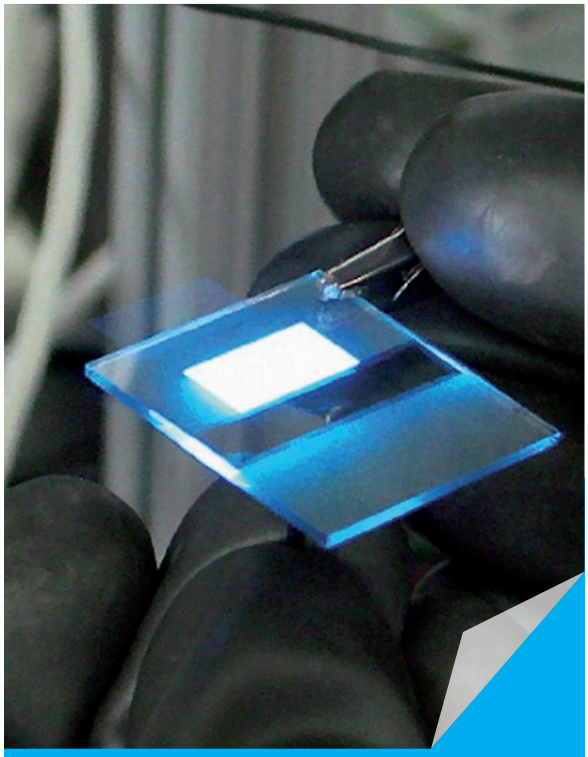


CONTEXT AND TOPICS OF OUR RESEARCH

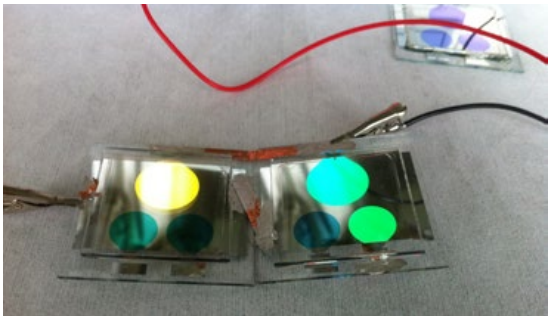
- Devices based on Organic semiconductors for lighting and light harvesting,
- Poor environmental impact (Green energy, low consumption, low costs of production),
- Versatile applications (large scale, on soft/ rigid supports + transparent/ opaque surfaces),
- Towards building integration (roofs, wall, windows..),
- Research supported through many collaborations with industrial key players and Universities Worldwide.

CHALLENGES

- Fabrication on new substrates (coated glasses and steel) towards innovative applications (Light emitting windows, Light emitting steel panels, Organic solar cells on soft Substrates..),
- Nature and properties of the substrate (roughness, transparency, conductivity, reflectivity..)
- Optimization of conductivity and transparency of electrodes (Evaporation vs Sputtering),
- New active materials (in-house synthesis, supported by theoretical calculation and modelling),
- Optimization of device architectures (stack definition and connections towards best efficiencies.

CHARACTERIZATION

- Optical and Electrical characterization according to international standards,
- Measurements of efficiencies of Oled's and OPV's,
- High resolution imaging techniques (AFM, TEM, SEM...)



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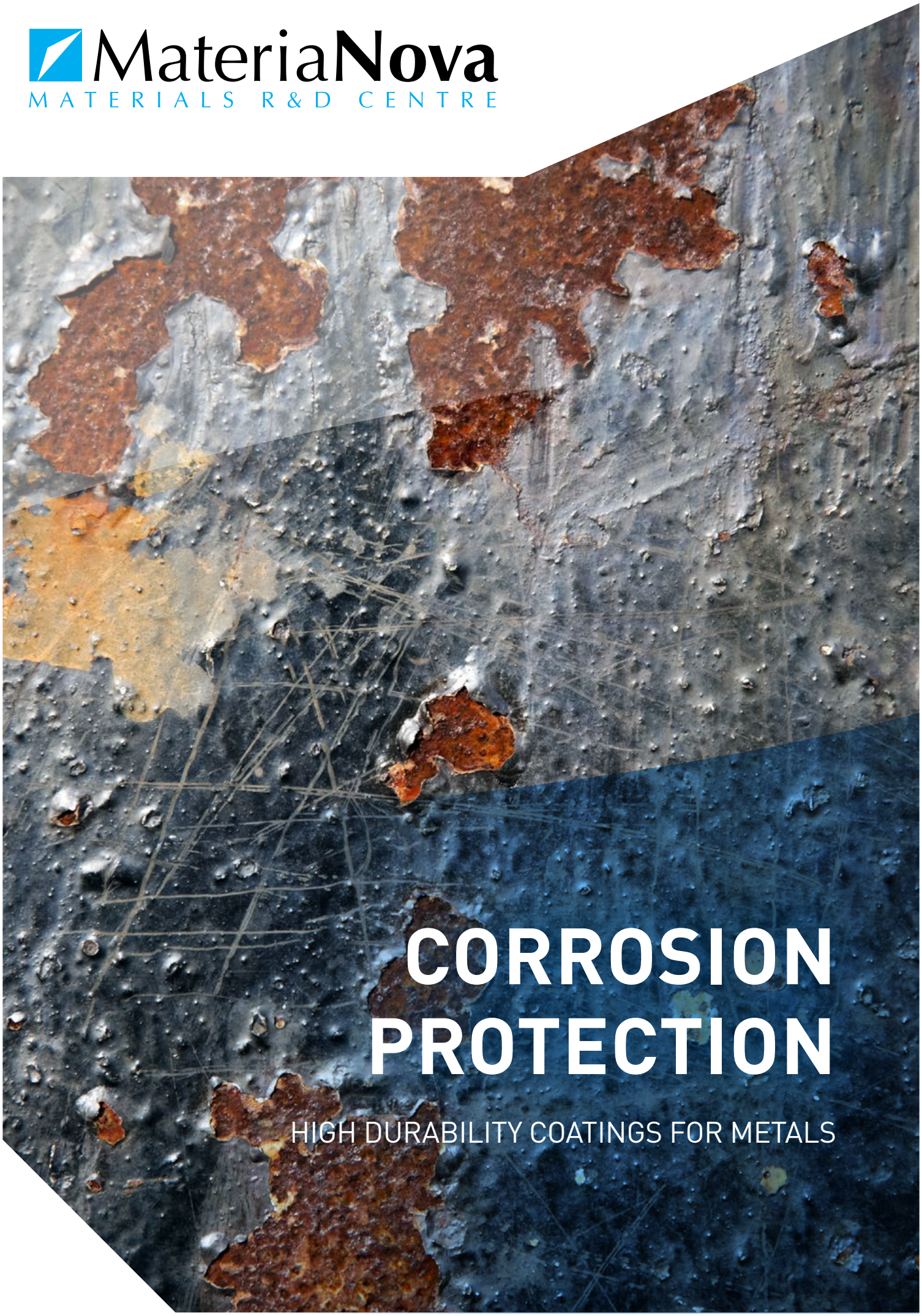


CORROSION PROTECTION

HIGH DURABILITY COATINGS FOR METALS

CORROSION PROTECTION

HIGH DURABILITY COATINGS FOR METALS

SKILLS/KNOW-HOW

ALTERNATIVE TO CR (VI)

Development of alternative passivation or conversion treatments based on hybrid organic/inorganic coatings

SELF-HEALING

Synthesis of inhibitor nanocontainers as anti-corrosion pigment for improved corrosion resistance and self-healing. Nanocontainers developed at Materia Nova are mainly based on nanoclay.

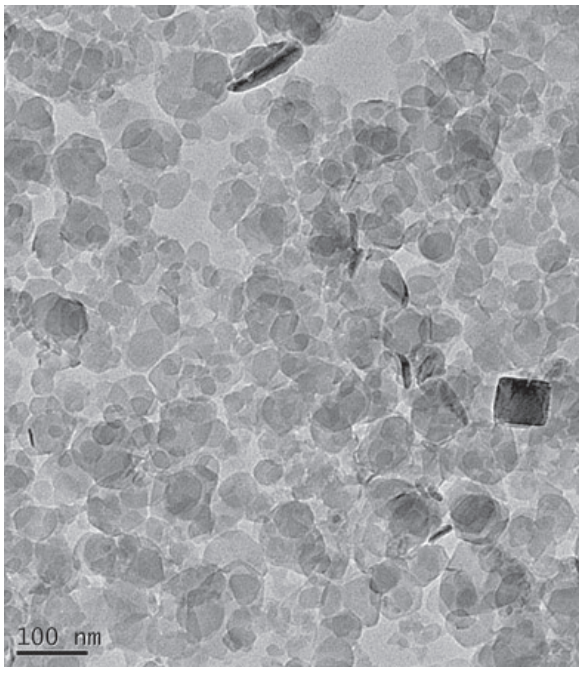
METAL PLATING

Environmentally friendly protective metallic coatings by plasma PVD and electroplating processing

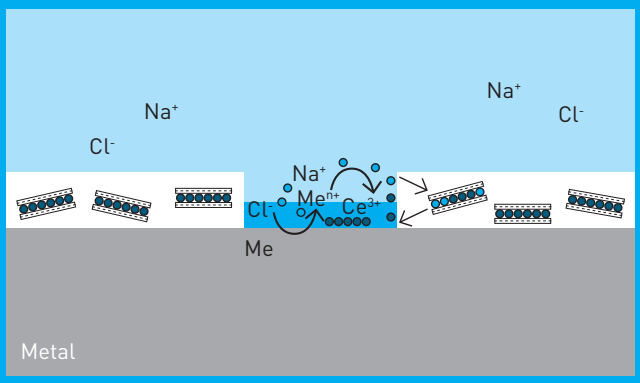
SHORT-TIME EVALUATION OF COATINGS PERFORMANCES AND DURABILITY

Development of specific evaluation methods based on electrochemical techniques

Evaluation of the compatibility of pretreatments with organic coatings in terms of adherence, edge protection, ...



Double layer hydroxide nanoclay



APPLICATIONS

- Selection and evaluation of non toxic inhibitors
- Self-Healing for an active protection against corrosion
- Coatings with increased barrier properties on any metallic substrate
- Study of the corrosion and protection mechanisms

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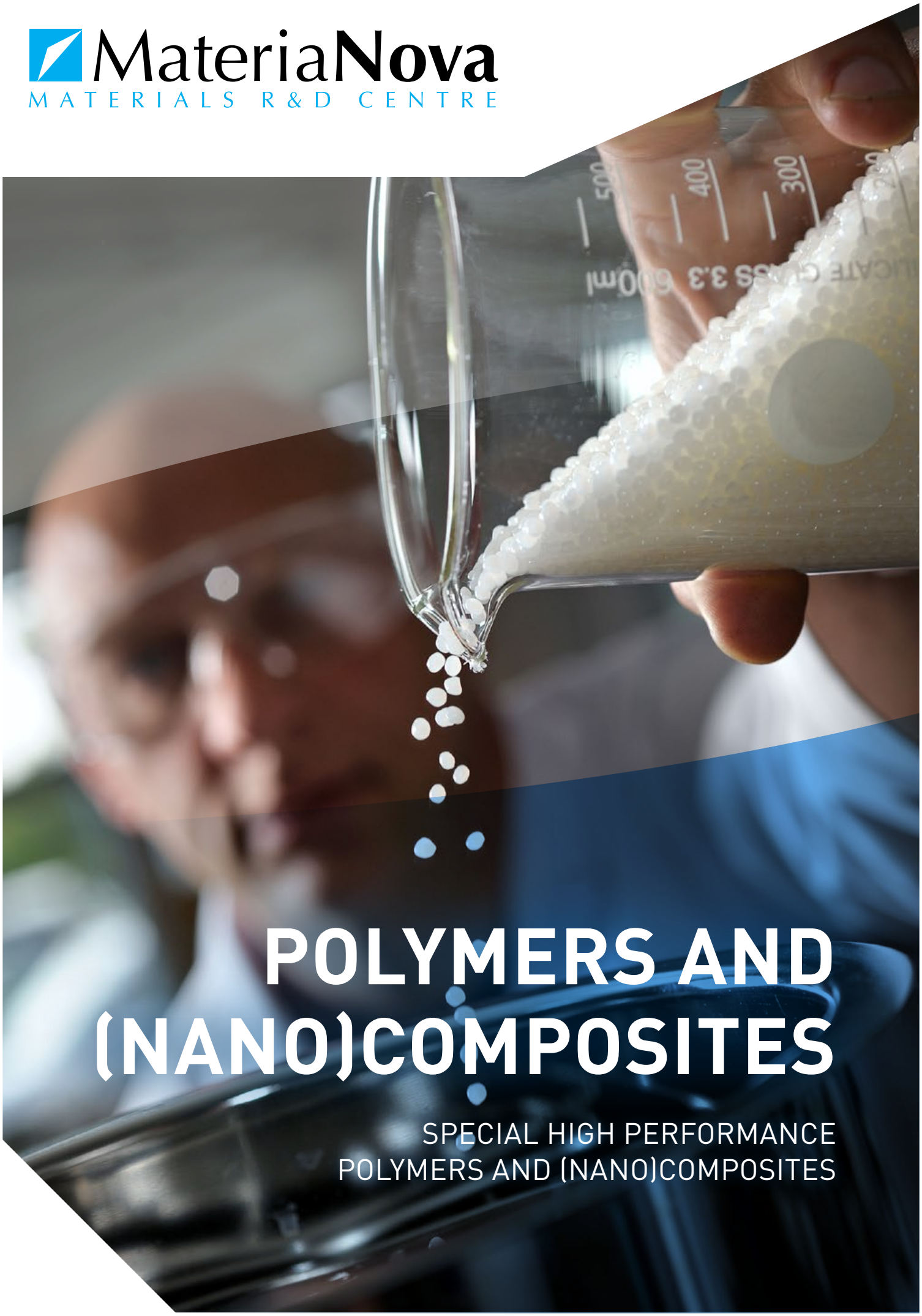

POLYMERS AND (NANO)COMPOSITES

SPECIAL HIGH PERFORMANCE POLYMERS AND (NANO)COMPOSITES

POLYMERS AND (NANO)COMPOSITES

SPECIAL HIGH PERFORMANCE POLYMERS AND (NANO)COMPOSITES

- Meet growing industrial demand for materials with improved properties
- Acceptable economic costs
- Low environmental impact
- Understanding the structure-properties relationship

SKILLS / KNOW-HOW

- Synthesis and formulation of polymeric compositions
- Synthesis of monomers, polymers and (nano)fillers derived from renewable resources
- Polycondensation, polymer blending and compatibilization
- Nanocomposites processing
- Reactive extrusion and dry mixing technologies
- Thermoset resins for composites, adhesives and coatings
- Improving fire behavior of polymeric materials by developing environmentally friendly flame retardant systems
- Materials characterization (thermal, mechanical, electrical, fire reaction, anti-bacterial, barrier, ...)

APPLICATIONS

- Fire proofing of polymeric materials for building and transport
- Highly conductive materials for electronics
- Biobased polymers with improved anti-bacterial properties for food packaging
- Polyurethane-based materials for insulation and painting
- Self-healing materials for transport
- Wood-Plastic-Composites with improved performances for building
- Improving mechanical resistance of elastomers
- Use of nanoparticles for efficient recycling of automotive parts
- Nanocomposites lightweight materials

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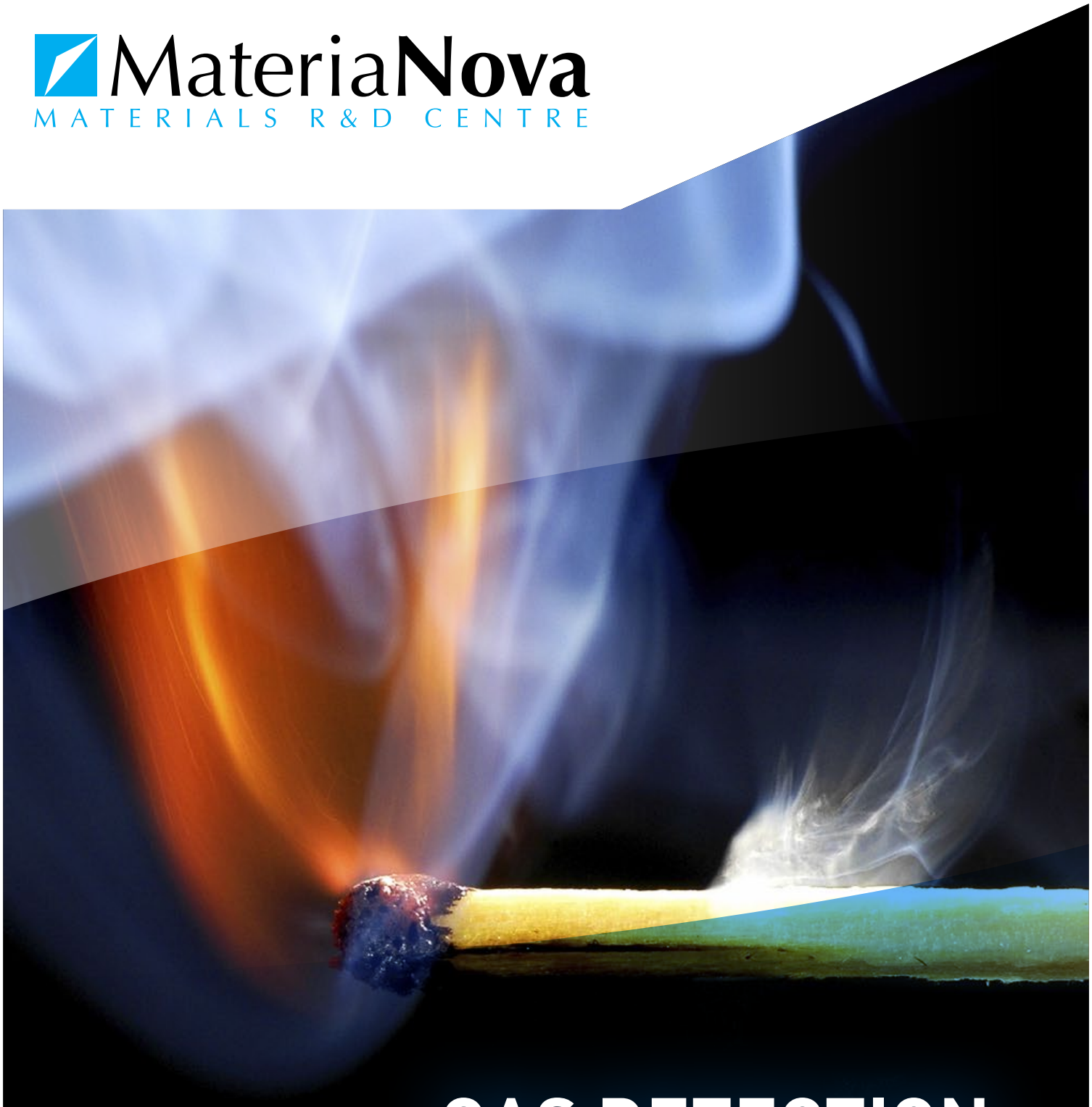

GAS DETECTION BY CHEMICAL SENSORS

FOR A BETTER CONTROL OF OUR ENVIRONMENT

GAS DETECTION BY CHEMICAL SENSORS

FOR A BETTER CONTROL OF OUR ENVIRONMENT

CONDUCTOMETRIC CHEMICAL SENSORS

This kind of sensors uses the electrical properties of semiconductor material sensitive to surrounding gases. The sensitive layer conductivity is a function of the gas concentration to be detected.

Applications

- **Control of atmospheric pollution in an urban environment** (indoor or outdoor): NO_2 detection, Ozone detection, CO ...
- **Safety in an industrial environment:** fire detection, hydrogen leak detection
- **Control of the processes in industrial environment:** regulation of combustion
- **Safety in the domestic environment:** CO and combustible gas leak detection
- **Indoor Air Quality Control:** smoke, formaldehyde detection ...
- **Air purifiers, ventilation control**
- **Automotive applications:** alcohol breath tests, air quality control in the cockpit, exhaust emissions control

Main Advantages

- High sensitivity
- Fast response & recovery
- Small size
- Low fabrication cost
- Robustness & long term stability
- Easy insertion in the electronics

OPTICAL FIBRE CHEMICAL SENSORS

Materia Nova, in collaboration with the University of Mons (UMONS), also works on the sensors based on optical fibre.

The sensor consists in the deposit (on the fibre tip or on fibre Bragg grating structure) of an appropriate indicator reacting with the chemical and/or biological analyte bringing a change in its optical properties.

OPTICAL FIBRE SENSORS CURRENTLY DEVELOPED

Sensors for H_2, NO_2, Fire detection, pH...

Advantages

- Possibility of measurement distributed over long distances
- Compact in size & very small volume
- Immunity to electromagnetic interferences 'noises'
- Multisensors on the same fibre
- Valid in liquid or gaseous phase

OUR EXPERTISE

- Development of sensitive materials with a reversible change in electrical or optical properties in contact with species to detect.
- Synthesis and microscopic design of the sensitive materials.
- Integration of the sensitive layers on substrates for transduction by methods involving the wet chemical methods (Spin-coating, Dip-coating, Spray-coating, Screen-printing, Electrodeposition...) or via vacuum deposition process (sublimation or sputtering).

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SURFACE TREATMENT BY PLASMA

EFFECTIVE, ECONOMICAL SURFACE TREATMENT WITHOUT EFFLUENTS

SURFACE TREATMENT BY PLASMA

EFFECTIVE, ECONOMICAL SURFACE TREATMENT WITHOUT EFFLUENTS

APPLICATIONS

Materia Nova has developed plasma technologies to modify the surface of materials. This powerful technology can develop new solutions for direct industrial applications. Materia Nova is specialized in the development of technological solutions for creating new surface properties through thin film deposition, decoration with nano-domains, ion implantation, grafting of chemical functions, structuration of the surface and cleaning.

To improve materials properties...

Photo : © N.Britun / Design by ex nihilo

Obtainable properties include:

- **Mechanical:** hard films, weak friction coefficient, diffusion barrier, anti corrosion, ...
- **Optical:** anti reflective, athermic, absorbent, surface selective, ...
- **Chemical:** improved adhesion, polymer functionalization, hydrophobic, hydrophilic, ...
- **Biological:** biocompatible, cell growth, differentiation, bactericide, ...

SKILLS

DEPOSITION OF THIN FILMS

PVD allows the deposition of **inorganic thin films** (metals, alloys, oxides, nitrides, carbides) with adaptable properties (composition, microstructure, surface topology, hardness, friction coefficient, color).

PECVD allows the deposition of **inorganic, organic or hybrid thin films** at low temperature. This technique enables the deposition of "plasma polymer" films with a very high and tunable crosslinking degree with turned up chemical function (NH_2, OH, CF...) at their surface. Both techniques could just as easily be considered for the coating of flat substrates or 3D objects of all types (metal, glass, polymer...).

DEVELOPMENT OF CUSTOMIZED POWER SUPPLY

Materia Nova has developed different **pulsed power supplies** (HiPIMS, BHV) capable of generating impulses which can control the flux and the energy of ion impinging conductive as well as insulating substrate.

POWDER MODIFICATION

Special configuration of PVD and PECVD coaters, operating at low or atmospheric pressure, was developed to treat not only flat macroscopic objects but also small 3D objects with different shapes like **powders, flakes, beads or fibers**. Such systems can modify the surface of powders or fibers, presenting a size ranging from 50 nm to 1 cm. New functionalities like antimicrobial, biocompatibility, corrosion and wear resistance or optical tuning can be obtained by such treatment.

ION IMPLANTATION

Ion implantation is a process that modifies the composition and structure of a materials surface (few microns) by interaction with a beam of ions. This technology is used to create, at the surface, a re-alloy, an amorphization, a nano-restructuration, a nano-hammering and chemical modification (nitriding, carburizing) of all materials (metals, ceramics, polymers). Ion implantation allows to increase hardness, fatigue limit, corrosion resistance, decrease the friction coefficient and control the cross-linking degree of polymers.

ATMOSPHERIC PLASMA

Atmospheric plasma torch is a spotted and powerful treatment operating in air and working with dry air or oxidizing and reducing gases. It allows surface cleaning by removing the carbon pollution, metallic oxide reduction in surface or ceramics deposition like SiOx to protect different substrates. Recent development on this technology allows to treat very stable materials like PTFE and to make deposition of metallic coating on all types of substrates (metal, polymer, glass ...).

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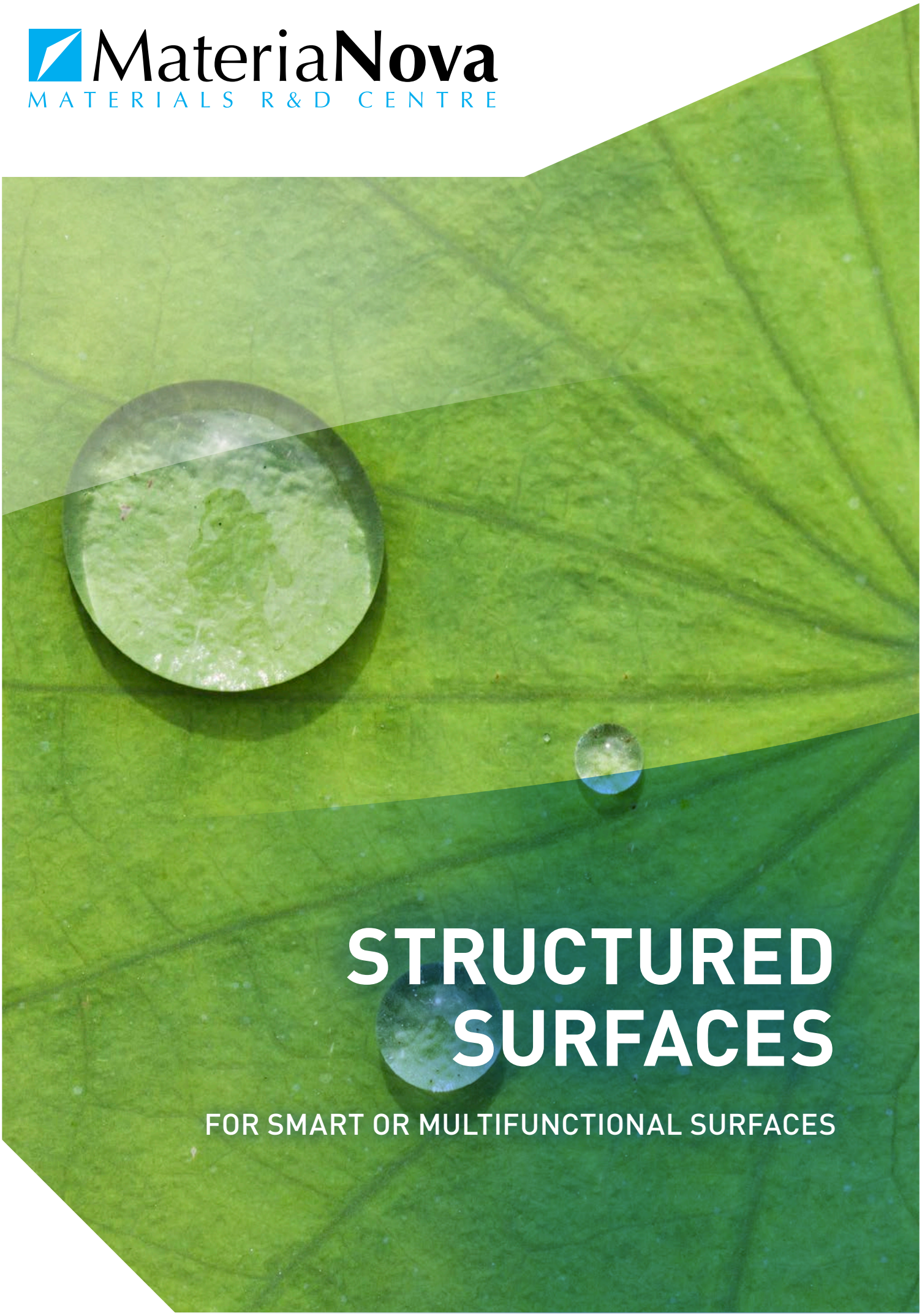


STRUCTURED SURFACES

FOR SMART OR MULTIFUNCTIONAL SURFACES

STRUCTURED SURFACES

Nanostructured surfaces developed by using particles (nano or submicron, nanospheres,...) and a hybrid coating formulation. The coating can be obtained by two different techniques: plasma (dry) and sol- gel (wet).

We use the **natural instabilities** existing in elastic or viscoelastic **thin layers** to generate **surfaces** with complex morphologies at sub-micrometric scales.

SCOPES OF APPLICATION

SUPERHYDROPHOBIC AND SELF-CLEANING SURFACES

Structuration of materials to make surfaces with superhydrophobic properties which can be useful in the following domains :

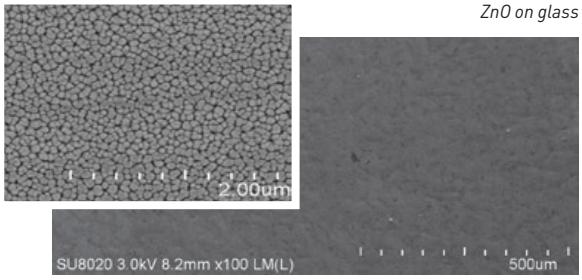
- **Aeronautics** (to avoid freezing phenomena),
- **Construction** (self-cleaning surfaces),
- **Medical** ("easy to clean" surfaces in surgical units).

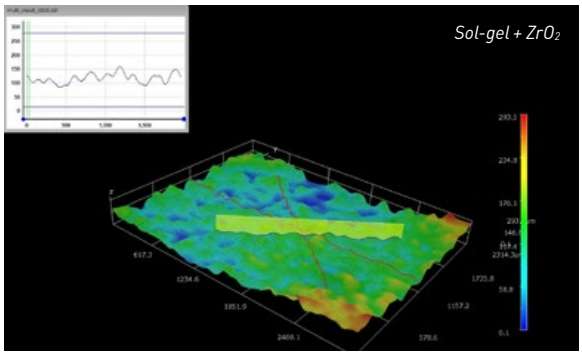
PHOTONIC SURFACES

Development of coatings concentrating diffuse light in order to increase the efficiency of solar cells in cloudy conditions (fluorescent concentrator).

Improvement of the luminescence of OLEDs (organic electroluminescent diodes).

ZnO on glass





SKILLS

MaNo develops and controls structuration methods of surfaces:

- **One-layer system by sol-gel:** (nano)particles dispersed in a mixture of solvent and fluorinated alkoxide precursors;
- **Multi-layer systems:** (nano)particles spin-coated and covered with a hybrid coating obtained by PECVD; chemically modified polymers.

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