Fraunhofer IFAM

Sputtering processes for deposition of nanostructured functional materials

Surface functionalization and production of alloy inks

Sputtering nanoparticles in liquids for the production of nanoscale inks for printing processes

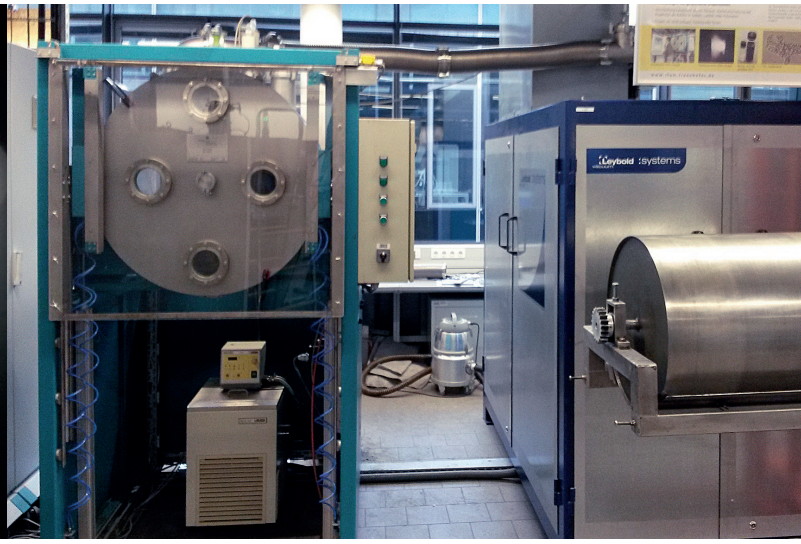
Component surfaces can be functionalized and customized coatings can be developed using physical vapor deposition (PVD) processes. PVD processes are used to create electrical, optical, catalytic, and even selfcleaning surfaces as well as for the production of nanoscaled inks.

Nanostructured Functional Materials

Surfaces can be coated with metals, metal oxides, or alloys using PVD processes. Using a co-sputtering process, composites or alloys can be deposited simultaneously or sequentially on various substrate surfaces. It is also possible to add reactive gases to the process to deposit metal oxides or nitrides. Furthermore dense or porous layers can be deposited and density gradients can be generated. In addition to the deposition of thin nanostructured functional layers on solid substrates, there is also the possibility of deposition of nanoparticles in liquids for the production of nanoscaled inks.

Alloy inks for printed electronics

In the growth market of »printed electronics«, the demand for inks and pastes containing metal particles is constantly increasing. In addition to nobel metals such as silver (e.g. for conductor tracks), gold (e.g. for medical applications) and platinum (e.g. for temperature sensors), printable metal alloys (e.g. CuNiMn) are required for strain and temperature sensors, for heating structures or for high-precision printable resistors. Other metal alloys such as AgPd or AgPdCu are suitable for solder connections for contacting electronic components.



PVD processes can be used for formulation of inks from special alloys that can be printed using digital printing technologies like inkjet and aerosol printing. Inks made from special alloys for digital printing techniques open up opportunities for cost-effective new products in the field of printed electronics and sensors in a wide variety of industries. This is particularly advantageous for small batch sizes and thus also for personalized products, because no masks and etching processes are required. The simple layout design using CAD enables quick customer-specific individualization of product properties. In addition, digital printing techniques are characterized by energy and resource efficiency in their properties as additive processes. This opens a great potential for significant cost advantages compared to non-additive technologies such as lithographic processes.
In addition, the use of aerosol printing offers the possibility of applying sensor structures directly to the 3D component surfaces.

Advantages of sputtering processes

- Flexible deposition of dense or highly porous thin layers
- Processing of metals, alloys or ceramics
- Layer thicknesses from a few nanometers to a few micrometers
- Adjustable layer porosities
- High purity separation using a physical process
- Homogeneous layer deposition and structuring using masks

Applications of highly porous thin layers

- Soot oxidation in motor vehicle catalytic converters (e.g. Pt, Co)
- Catalytic converters for carbon monoxide oxidation (e.g. Au)
- Self-cleaning surfaces with photo-oxidation (e.g. Ag-TiO2)
- Use in gas sensors for hydrogen detection (e g. Pt)

Printing technologies

In combination with digital printing technologies, PVD processes open up various applications for producing electronic parts and components. Sputtering nanoparticles in liquids allows the production of the nanoscale inks (e.g. CuNiMn) for printing processes.

Our offer

Fraunhofer IFAM offers the following R&D services:

- Deposition of nanoscaled metals or metal oxides from the gas phase on substrates to generate functional surfaces
- Sputtering of metals or metal oxides from the gas phase in liquids for the production of nanoscaled inks
- Reactive sputtering using magnetron or gas flow process
- Optical and functional characterization of sputtered layers and liquids

Left: Plasma of a gas flow sputter system
Right: Sputtering in liquids for alloy inks

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