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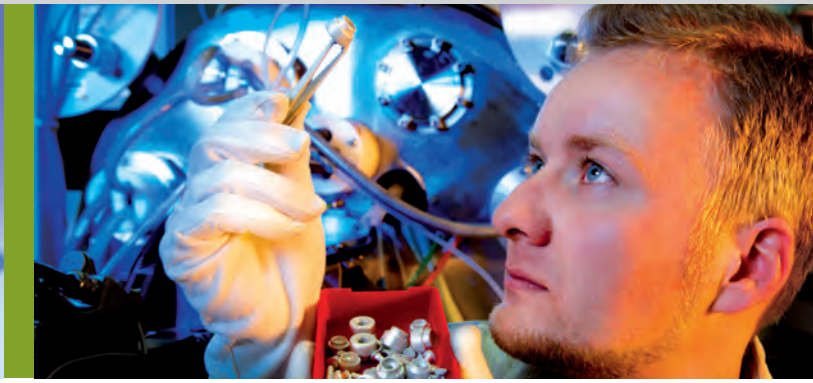

COATING OF SMALL AND MASS-PRODUCED COMPONENTS AS BULK GOODS

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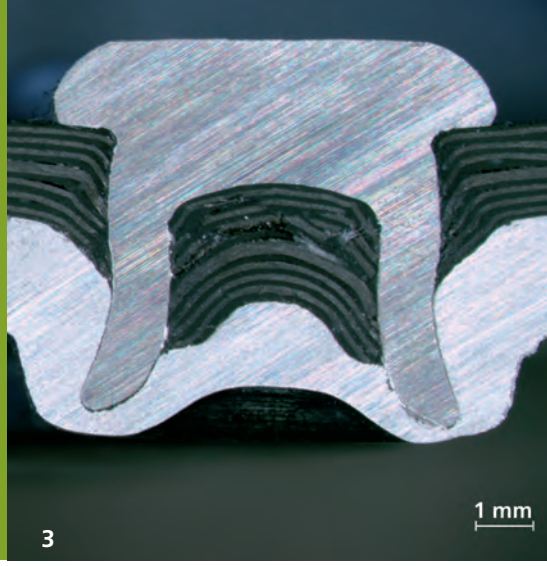
The development of coating technologies for small and mass-produced components processed as bulk goods is one field of activity at Fraunhofer FEP.

The advantages of vacuum coating compared to conventional wet-chemical or metallurgical coating processes of small components comprise a high layer quality and a broad range of achievable layer structures. Furthermore, vacuum coating processes are environment-friendly and cost-effective.

At Fraunhofer FEP, a coating plant is being used in which small and mass-produced components can be processed as bulk goods. This plant combines the core technologies of plasma-activated high-rate deposition and pulse magnetron sputtering. Moreover, hollow cathode-assisted sputter-etching paves the way for good adhesion of the layers on the substrates.

Our primary focus is targeted onto the development of corrosion protection layers on rivet elements for the car manufacturing and rail vehicle industries. The requirements concerning corrosion protection are enhanced by the increasing use of material combinations in hybrid design (e. g. metals and reinforced composites). Multilayer vacuum coatings providing corrosion protection, diffusion barrier, and passivation functions have already shown high promise in initial application-related tests.

The PVD coating technology that has been developed can also be adapted for sliding, decorative, scratch-resistant, or abrasion-resistant layers.



Technologies

- Plasma pre-treatment
- Pulse magnetron sputtering
  - of adhesion-promoting layers
  - of functional layers (e. g. conductive, decorative)
- Plasma-activated high-rate deposition
  - of low melting point metals and alloys (e. g. Al, AlMg, Cu, etc.)
  - of compound layers through reactive processes (e. g. Al_2O_3 for passivation)
- Substrate agitation in a rotating drum

Properties of corrosion protection layers

- Dense and adherent layers with fine-grained microstructure
- Typical layer thickness of 10 µm on the outer surfaces of bulk products
- Uniformity of the layer thickness ± 20 percent
- Corrosion-resistant
  - over 1000 hours in the salt spray test (DIN EN ISO 9227)
  - over 6 weeks in the VDA (German Association of the Automotive Industry) alternating test (VDA 621-415)

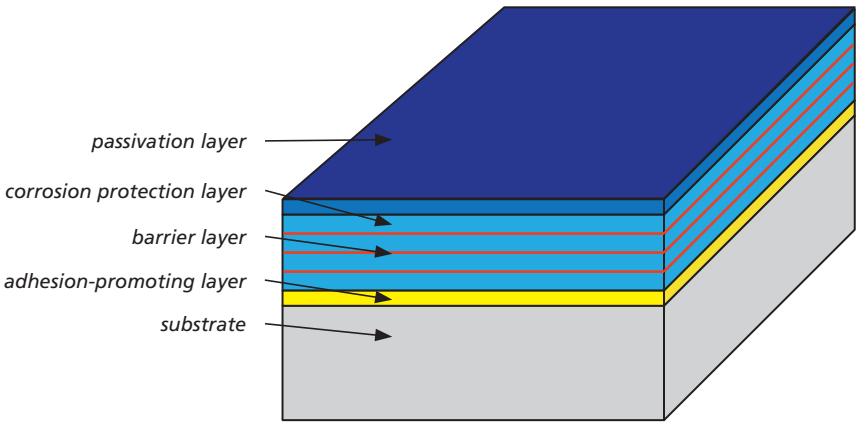
Possible substrates

- Bulk products (rivets, bolts, pins, balls, links, nails, etc.)
- Typical dimensions: 2 ... 20 mm
- Max. batch weight: 30 kg
- Low-abrasion materials (e. g. metal, glass)
- Heat resistant materials (up to 300°C)

Our offer

- Technology and process development
- Feasibility studies
- Sample coatings for introduction of new products onto the market
- Supply of key components, e. g. power supply units, pulse and process control units
- Technology transfer

4 Schematic representation of a multilayer system for corrosion protection



1 Blind rivet sleeves after coating
2 Coated semi-tubular punch rivet
3 Cross-section of a CFRP-aluminum joint with coated semi-tubular punch rivet

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