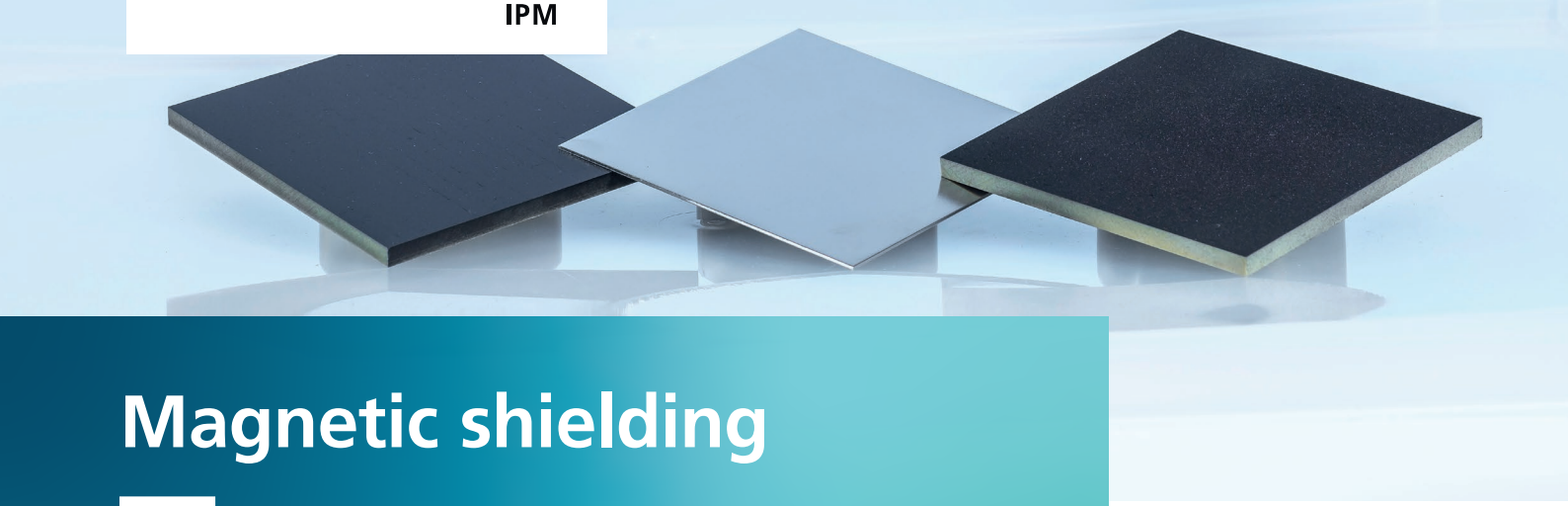
Fraunhofer IPM



Magnetic shielding

Spray coating for 3D geometries

Novel spray-coated materials for magnetic and electromagnetic interference shielding enable thin, uniform layers, even for components with complex geometries.

Fraunhofer IPM designs tailor-made magnetic shielding for demanding applications. Our spray-coating approach enables compact, multilayer shields. By tuning spray-coated materials, we meet diverse requirements – from broad frequency coverage and high-field performance to corrosion resistance.

Seamless application

Traditional shielding materials like mu-metal and other high-permeability metals are highly effective at low frequencies. The material is typically used as sheet metal or foils, which has certain disadvantages, such as overlaps and installation edges. The spray-coating approach makes it possible to apply magnetic shielding directly to the relevant shielding geometry. Alternating layers of mu-metal and aluminum or copper are spray coated onto complex 3D geometries, ensuring a precise fit. The process successfully combines the high permeability of mu-metal for direct current (DC) and very low frequencies with the eddy current damping of conductive metals for the kilohertz (kHz) or higher range. The result is a gap-free, compact, broadband shielding operating from DC to 100 kHz.

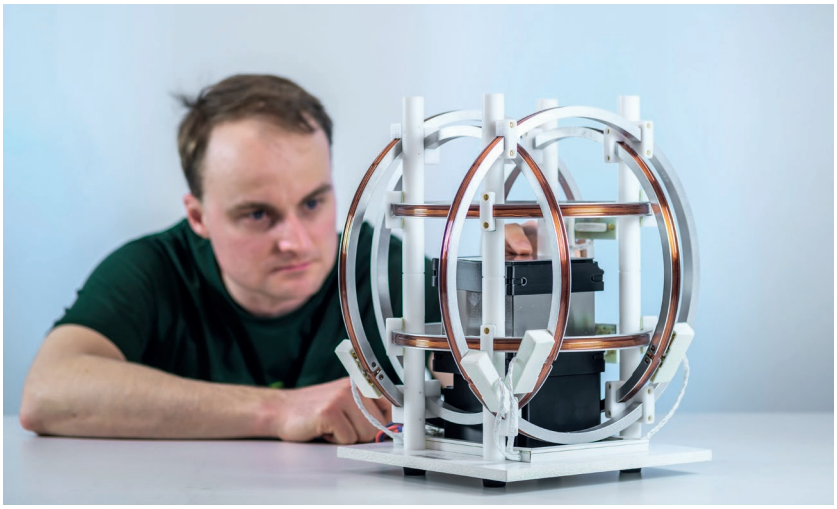
Multi-layers for increased shielding effect

The geometry, number of layers, and layer succession can be selected flexibly. The achievable shielding value (shielding factor or damping in dB) depends on the specific application and geometry and can be customized.

The layer architecture is tailored to the target area, with mu-metal shielding low-frequency fields up to approx. 10 Hz, while aluminum and copper shield higher frequencies. For stronger magnetic sources, an iron base layer with higher saturation magnetization can be applied. Available materials include mu-metal, aluminum, copper, iron, and – depending on thermal and mechanical requirements – invar and stainless steels.

Our service

Submit your frequency range, target shielding factor, along with a component sketch or CAD data. We will quickly develop a dedicated shielding concept with layer architecture and target values for your application.



The performance of new shielding materials is tested in an experimental setup. Here, a cube made of mu-metal plates is placed at the center of a 3-axis Helmholtz coil system.

Application areas

New Space – source and victim shielding in densely packed satellite platforms, for example in the vicinity of reaction wheels and in electric drives with relevant DC and low-frequency fields. Space-oriented designs, for example for vacuum/outgassing, temperature cycles, and shock/vibration, are available on request.

E-Mobility – improves EMC performance, reduces stray fields and protects field-sensitive sensors in SiC-based inverters, DC/DC converters, on-board chargers and the eAxle environment. It is suitable for typical DC and switching frequencies in modern power electronics.

Operating principle and verification

Field guiding through mu-metal and iron combined with eddy current damping through aluminum/copper interact in directly contacting layers, producing a broadband shielding effect. Target shielding dimensions are determined through simulation and measurement at defined locations and field strengths. The results are reported as a shielding factor or attenuation value in dB across the relevant frequency range and depend on the application and geometry.

Process and quality

Materials engineering design, magnetic simulation, and process reliability are key factors for application. Dedicated test setups measuring from DC up to 100 kHz are used for validation and documentation. We tailor the coating parameters to specific requirements, also for space-related applications.

Our offer

- Specification analysis: frequency window, target shielding factor, geometry, substrate, environmental conditions
- Layer design: composition of mu-metal, aluminum/copper, optional iron base layer, integrated corrosion protection
- Simulation: magnetic design, variant comparison, target values (shielding factor/damping in dB)
- Prototyping and validation: measurements from DC to 100 kHz in a specified reference setup, comparison with sheet/foil coating

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