

Abstract

# Prototyping Platform for Laser-Based Sensor Technologies: Inspection of Conversion Coatings on Alumina <sup>†</sup>

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**Abstract:** Transferring laser-based sensors into industrial applications (for instance, for contact and destruction-free inline quality control of alumina alloys) is very challenging due to laser-safety regulations and the complex implementation requirements of individual technological infrastructures. In order to open laser-based sensor technology even for small to medium size enterprises, we introduce a prototyping platform for laser-based sensor technologies that enables fast, error-free, flexible and low-cost transformations in the industry. As an example, the transformation of a laser-based sensor concept using coherent light scattering at technical insulating films is shown. The transformation of this type of sensor for inline quality control is particularly demanding due to the requirements of probing transparent conversion coatings (with a thickness of less than 70 nm) that commonly applied electronic techniques fail to affect. The conversion films are produced on the top of cold-rolled, unpolished alumina so that coherently scattered laser light is regarded as superposition from diffuse scattering processes at the surfaces/interfaces, inclusions, and/or layer imperfections. Analysis is realized by extending the principal approach of reflectometry and considering the role of diffuse and specular scattering together with the concepts of light interferometry. The functionality of the transformed sensor was successfully validated using five different conversion coating thicknesses on AA3003 alumina substrates.

**Keywords:** optical sensory; conversion layer; aluminum alloy; rough surface; agile prototyping; modular systems



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