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Thin Film Sensors for Additively manufactured components

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Additive Manufacturing (AM) offers a whole new spectrum of design and fabrication potentials. Components of complex structures can be realized and a significant decrease in weight of the workpiece can be achieved. To further increase the applicability of AM components integrated thin-film sensors like, e.g., resistance strain gauges or thermometers are of great value.
This work evaluates the requirements of integrating thin-film sensors in the fabrication process of AM parts. We concentrate on workpieces fabricated by Selective Laser Sintering (SLS) and using powdered polyamide (PA12) as a non-conductive material to abstain from using one or rather two additional insulating layers during process development and evaluation.
Fabrication of thin-film sensors requires a smooth and defect free surface. As additive manufactured parts are known to incorporate a certain quantity of bulk and surface defect, caused by process parameters as variations of powder size or distribution or application of unideal design parameters, a thorough study of the actual defect rate is necessary. Based on this statistical parameter the probability of a working thin-film sensor with respect to its length, depth, and width can be determined and, hence, the minimal sensor size.
Inter- or post AM surface treatment is investigated to increase the probability of obtaining a working sensor. Furthermore, to integrate a thin-film sensor into an AM fabricated workpiece, the printing process has to be interrupted and resumed at the exact position. To achieve this, one must know both, the position of the reinserted workpiece with an uncertainty of a few micrometers at the most (powder size and, hence, layer height being 20 – 40 µm), and the machining tools, i.e. scraper, roller, laser focus point, as well.

Keywords
Thin Film
Sensors
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Polyamide
Surface Quality