



ADDITIVE MANUFACTURING OF INDIVIDUALIZED, EMBEDDED STRAIN GAUGE SENSORS

Task

The demand for intelligent sensors for digital solutions is steadily increasing – for use in autonomous vehicles, for the Internet of Things or Industry 4.0. The suppliers of such sensors are confronted with price erosion, increased requirements and increasing competition, all of which raise the pressure to develop new market strategies. Conventional strain gauges are mass-produced and glued onto components; gauge position and adhesive film thickness can vary, which can influence the measurement results. Conventional strain gauge production is designed for mass production so that individual sensor designs for special measuring tasks generate high costs.

Method

Fraunhofer ILT is currently developing the additive manufacturing of individualized sensors connected to the component. To accomplish this, it successively prints the necessary layers and structures of different materials directly on the component and then thermally post-treats them by means of laser radiation (sintering, melting, curing, etc.). For strain gauges, the insulation layer, measuring grid and encapsulation are applied layer by layer. A previous cleaning and activation of the surface is also possible by means of laser radiation. Due to

the temporally and spatially controllable energy deposition, in contrast to conventional thermal processes, it is not required to completely heat the component (furnace) or to irradiate the entire surface (flash lamps). Thus, temperature-sensitive components can be selectively coated.

Results

Using the innovative laser process, the institute can apply printed multi-material layer systems directly on the component to produce sensors for the measurement of strains etc. Thanks to the inline-capable, automatable process and its digital nature, individual measuring grid geometries down to lot size 1 can be generated without the need for masks or tool change. The coating is possible on polymers, glass and also metals.

Applications

Strain gauge sensors are used wherever mechanical load conditions should be measured and production equipment and sensitive products protected against mechanical overload. The data can be used for a wide spectrum of applications: to increase the productivity or quality of the production systems, to plan maintenance cycles, to monitor load scenarios or even just discrete conditions of loads (on/off).

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- 2 Printed and laser-functionalized strain gauges on polymer films.
- 3 Printed and laser-functionalized strain gauges of different designs.