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Smart sensor integration by combining 3D-printing and printed electronics

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3 D-printing gains great interest enabling the production of complex shapes using less material than traditional subtractive manufacturing methods. In addition, printed electronics allow direct writing of electrical devices on various substrates. Printed electronics typically uses common printing technologies suitable for defining patterns on material, such as screen printing, but also digital printing like inkjet, aerosol jet and dispensing. In this paper we report on a combination of 3D-printing and printed electronics to directly integrate functionalities like sensors, heating structures and conductive traches into 3D-printed polymer parts. For this purpose, a fused filament fabrication (FFF) technique has been combined with a digital ventile printing technique. Metal structures as well as ceramic or dielectric structures can directly be applied on the surface of a pre-produced 3D-printed polymer part. In addition, structures can be integrated during the 3D-printing process to ensure a high functional integration density. Sintering and thermal activation of in special metal structures can be ensured by use of local heating and photonic curing. The integration of digital printing into a FFF-process enables high design freedom of multi-functional parts for e.g. industrial products, structural health monitoring, Internet-of-Things (IoT)-applications and big data analysis. Resulting integrated functionalities are discussed in view of processing stabilities as well as reliability and reproducibility, respectively.

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