

Smart sensor integration by combining 3D-Printing and Printed Electronics

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Abstract

3D-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, strucutres 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.

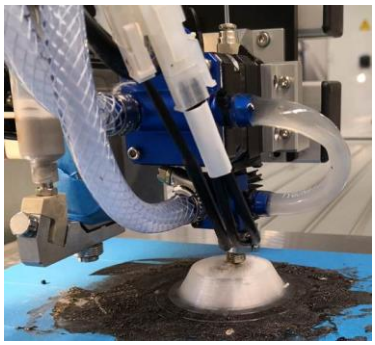


Figure 1: Combination of Fused Filament Fabrication and Digitlal Printing

Recent Publications

Godlinski, Dirk; Zichner, Ralf; Zöllmer, Volker; Baumann, Reinhard R.: *Printing Technologies for the Manufacturing of Passive Microwave Components: Antennas;* IET Microwaves, Antennas & Propagation Vol 11 Iss 14 (2017) 2010–2015

Dirk Lehmhus, Claus Aumund-Kopp, Frank Petzoldt, Dirk Godlinski, Arne Haberkorn, Volker Zöllmer, Matthias Busse: *Customized Smartness: A Survey on Links between Additive Manufacturing and Sensor Integration*. DOI:10.1016/j.protcy.2016.08.038

Angelina Besganz, Volker Zöllmer, Robert Kun, Edit Pál, Lorenz Walder, Matthias Busse: *Inkjet Printing as a Flexible Technology for the Deposition of Thermoelectric Composite Structures*. 12/2014; 15:99–106., DOI:10.1016/j.protcy.2014.09.043

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Edit Pal, Robert Kun, Christina Schulze, Volker Zoellmer, Dirk Lehmhus, Marcus Baeumer, Matthias Busse: *Composition-dependent sintering behaviour of chemically synthesised CuNi nanoparticles and their application in aerosol printing for preparation of conductive microstructures*. Colloid and Polymer Science 07/2012; 290(10-10):941-952., DOI:10.1007/s00396-012-2612-3

Biography

Volker Zöllmer obtained his diploma in mineralogy at the University of Kiel, Germany in 1998. He finished his PhD within the group of Prof. Faupel (University of Kiel, 2003) with the focus on diffusion in metallic glasses and undercooled liquids. Since 2002 he continued his work at Fraunofer IFAM, Bremen, as head of department “Functional Printing” and since 2018 “Smart Systems”. The topics include functional printing, ink- and paste development, 3D-printing and 3D printed electronics.

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