Fraunhofer IGCV

Fraunhofer Institute for Casting, Composite and Processing Technology IGCV

Additive manufacturing

General Information

Currently, about 30 scientists are doing research in additive manufacturing processes. We are working on product development of additively manufactured components that are specifically geared towards sensor-integrated multi-material components. For industrial implementation in production, we are researching suitable methods of factory planning. In addition to project-based knowledge transfer, we bear responsibility for industry development by sharing our knowledge through memberships in numerous committees and boards.

In our AMLab, we conduct research together with the *iwb* of the TUM on various processes, for example Laser-based Powder Bed Fusion of Metals (PBF-LB/M) or arc-based additive manufacturing. In addition, we are experts in the fields of:

- Extrusion of fiber-reinforced polymers,
- Liquid Deposition Modeling of composites and
- High-pressure cold gas spraying

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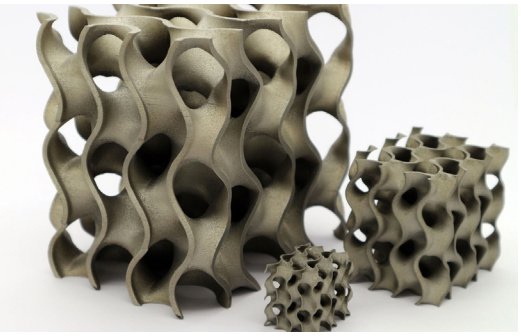
Additive manufacturing is a cross competence of Fraunhofer IGCV with currently three focal points:

1 | Additive manufacturing of metal components and metallic multi-material components

2 | Additive manufacturing of polymers and composites

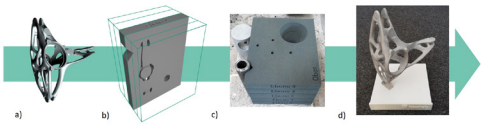
3 | Additive processing of materials for casting technology

- Sand-based additive manufacutring



Laser-based Powder Bed Fusion of Metals (PBF-LB/M): Gyroid structure with stainless steel alloy

Standardization of fiber volume content (FVG) determination using thermogravimetric analysis (TGA).



Wheel carrier produced by stack casting for the Formula Student racing team of TU Munich a) CAD model, b) Virtual layers, c) Stack of layers, d) Finished cast component

1 | Additive manufacturing of metal components and metallic multi-material components

At Fraunhofer IGCV, research is conducted primarily on direct metal additive manufacturing processes, where the metal component with full-fledged properties is created directly by additive fabrication. Besides high-pressure cold gas spraying and wire and arc-based Directed Energy Deposition (DED), we mainly use the Laser-based Powder Bed Fusion of Metals (PBF-LB/M). It enables a new form of function integration, for example sensor integration.

The multi-material processing is a second important part of our research. Hereby, at least two different materials are used, which can have any distribution in the build direction and in the build plane. It is our goal to support the rapid advancement of this technology by constantly optimizing and improving in-, pre- and post-processes and thereby increase quality and efficiency.

Equipment

- PBF-LB/M - Multimaterial: Aconity One; SLM Solutions SLM 280; SLM Solutions 250 HL;
- PBF-LB/M - Standard: CConcept Laser M1 Cusing; SLM Solutions 125 HL; EOS M280/ M400 / M290; Trumpf TruePrint 1000 Green/ TruePrint 2000 Dual; Test bed (DIY) 2
- DED - wire-based: Trumpf TruDisk 4001
- Optics: Precitec CoaxPrinter
- Robot: KUKA KR60 (Robot),
- wire conveyor unit: Dinse DIX | FDE-PN 100L
- DED - wire-powder-based: CMT-Advanced 4000, 6-Axis-Kuka-Robot KR15/6; High-Pressure Cold Gas Spraying; Fronius TPS 400i;6-Axis-Yaskawa-Robot 2-Axis-Positioning

2 | Additive manufacturing of polymers and composites

Additive manufacturing processes have their origins in plastic processing. In more than 30 years of development, plastics processing methods have now reached a level of maturity that enables the series production of high-performance polymers in certified industries such as aviation or medical technology.

At Fraunhofer IGCV, research focusses on two plastics processing additive manufacturing techniques:

- Liquid Deposition Modeling for the production of fiber-reinforced plastics with thermoset matrix.
- Extrusion technologies, such as Fused Layer Modeling.

In addition, Fraunhofer IGCV is involved in cooperation with numerous partners from research and industry in the material characterization of additively manufactured plastic parts, for example at elevated operating temperatures.

Equipment

- MEX: 3D Systems ProJet HD3000; Creality3D Ender 3 | 3; Ender 3 Pro; Makerbot 5th Generation| 2; Voxeljet AG VTS 128; Atum 3D; Markforged Marc Two; RepRap X400 Pro V3; Stratasys F270 | µPrint SE plus; Ultimaker Original+ | 2 Extended + 3 | 3 Extended; Zortrax M200| M300
- PBF-LB/P: EOS Formiga P100; Sintratec Kit (Laser sintering system)
- VAT: Elegoo Mars 2 Pro; Formlabs Form 3

3 | Additive processing of materials for casting technology

- Sand-based additive manufacutring

Fraunhofer IGCV has unique expertise in binder jetting technology (an additive manufacturing process). In this process, a powder material is solidified layer by layer by the local, precise introduction of a binder material via pressure heads with several 10,000 openings.

The focus of the research work is on the processing of casting-relevant materials, such as molding sands. Different molding sands and binder materials are being researched that behave particularly economically and technologically favorably in casting processes. As a result, additive manufacturing processes do not compete with conventional manufacturing technology but act cooperatively as enablers of improved (shortened) process chains in the casting technology.

Equipment

- Binder Jetting: Voxeljet VX10001 | VXC8001 | VX5001 | Test axis