DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

Seminario

SHAPING OF ALUMINA CERAMICS AND ALUMINA BASED COMPOSITES BY SELECTIVE LASER MELTING/SINTERING AND LAMINATED OBJECT MANUFACTURING

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Sala Riunioni Grande*
Corpo A
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*capienza COVID = 40 persone

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Abstract
Shaping of complex geometries with high precision and having both high strength and fracture toughness of the workpiece material is a key challenge in ceramics processing. This is in combination with long processing time and cost-intensive post processing a major obstacle for a broader application of high tech ceramic parts. Additive manufacturing (AM), for example direct Selective Laser Sintering and Melting (SLS/SLM) and Laminated Object Manufacturing (LOM) could be a solution to these problems.
The absence of understanding the interaction of laser light sources with the ceramics based materials and the slow sintering kinetics of ceramics is today the cause of no existing SLS/SLM process available to consolidate ceramic powders to dense structures. Severe problems like crack formation and weak densification have to be still approached for the production of high performance ceramics with convenient material properties. Based on our approach the starting ceramic powders are granulated by spray drying to achieve a high flowability, a high powder bed packing density. Colored nano metal oxides were uniformly implemented within the granules to improve the interaction with the used pulsed or continuous wave green and infrared lasers [1]. By a thermal treatment the powder density could be further increased with no detrimental effect on the flowability [2]. The focus of this work is on the optimization of raw powders ratio and additives to improve the interaction between the laser and the granules. The reduction of thermal stresses and cracks formation during laser-processing is also a major challenge to be solved in the ongoing work.
In LOM different sheets are laminated layer by layer. Subsequently, for each applied layer, the contour is cut based on a CAD model using a knife or a laser beam and the redundant part is removed. For the production of ceramic components by means of this method, especially ceramic films and preceramic papers are particularly suitable [3]. Since structures made of preceramic papers also have a wide range of different porosity, the combination with LOM offers various possibilities [4], as for example to produce ceramic-metal interpenetrating composites by infiltration of alloys into the porous paper-derived preforms [5].

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[5] S. Pfeiffer, H. Lorenz, Z. Fu, T. Fey, P. Greil, N. Travitzky, Al2O3/Cu-O composites fabricated by pressureless infiltration of paper-derived Al2O3 porous preforms, Ceram. Int. 44(17) (2018) 20835-20840.

Bio

Stefan Pfeiffer graduated (MSc) in Materials Science and Engineering at Friedrich-Alexander-Universi-tät Erlangen-Nuremberg. During his studies, he specialized in additive manufacturing (AM) of ceramic-based materials in the group of Prof. Dr. Nahum Travitzky. The focus here was on Laminated Object Manufacturing (LOM) of ceramics. During his scientific stay at Universidade Federal de Santa Catarina in Florianopolis (Brazil), he also gained experience in powder technology by performing synthesis of hydroxyapatite by precipitation. At Empa Dübendorf, he was able to further deepen this knowledge in powder technology. He is currently working in the nanopowders and ceramics group of Prof. Dr. Thomas Graule, where he is focusing on powder preparation for Selective Laser Sintering and Melting (SLS/SLM) of different oxide ceramics in terms of spray granulation and nanopowder dispersion.