



SOL-GEL CHEMISTRY AND ADDITIVE MANUFACTURING: POTENTIAL FOR CERAMIC FABRICATION

**Giorgia Franchin¹, Alice Zanini¹, Giulio Giometti¹, Marco Lorenzo D'Agostini¹,
Anna De Marzi¹, Kai Huang¹, Paolo Colombo^{1,2}**

¹ University of Padova, Department of Industrial Engineering, Padova, Italy; ² The Pennsylvania State University, Department of Materials Science and Engineering, University Park, PA USA

ABSTRACT

Additive manufacturing of polymeric materials has reached a far greater maturity with respect to ceramics, the latter being limited by their high melting temperatures and conventional sintering from powder feedstocks. Processing slurry-based feedstocks, in which powders are present, poses additional challenges: a high amount of powder is required to promote densification, and results in high viscosity, scattering and sedimentation phenomena in vat photopolymerization processes, as well as clogging problems at the nozzle for extrusion-based processes. Our research activities has therefore been focusing on additive manufacturing of ceramics from liquid feedstocks; in particular, we investigated the use of preceramic polymers as well as geopolymers and sol-gel solutions. Despite the many advantages related to their liquid nature, there are also some challenges related to the reactivity of sol-gel systems and to the high amount of solvent usually present. Here, we present our strategies for producing high quality ceramic components using a variety of liquid feedstocks and different additive manufacturing techniques, from direct ink writing and digital light processing to robotic and volumetric additive manufacturing.