ADDITIVE MANUFACTURING OF C/C-SiC BY FUSED FILAMENT FABRICATION

Stefan Schafföner, University of Bayreuth, Germany
stefan.schaffoener@uni-bayreuth.de
Wolfgang Freudenberg, University of Bayreuth, Germany
Nico Langhof, University of Bayreuth, Germany

Key Words: C/C-SiC, PEEK, fused filament fabrication, additive manufacturing

Currently, ceramic matrix composites (CMC) are usually fabricated by subtractive manufacturing processes, like cutting, milling and grinding of semi-finish components. Additive manufacturing (AM) of CMC enables a cost reduced manufacturing process due to the near net-shape processing and the possibility to align the fibers in load direction for an optimized mechanical performance. Within this study, carbon fiber reinforced SiC (C/C-SiC) was produced by additive manufacturing, applying the fused filament fabrication (FFF) technique and the LSI-process (liquid silicon infiltration). Due to the FFF method, it is necessary to use thermoplastic filaments. Therefore ("CF-PEEK") filaments with thermoplastic polyetheretherketone (PEEK) were applied as the matrix and C-precursor, and carbon short-fibers (< 250 µm) as reinforcements were applied in order to fabricate the near net-shape CFRP (C-fiber reinforced plastic). In order to prevent the re-melting of thethermoplastic PEEK within the as-printed CFRPs during pyrolysis at 1000 °C, a prior crosslinking step below the melting temperature is required. Therefore, a dwell time of 48 h at 325 °C in air was introduced to stabilize and crosslink the CFRP. Due to the stabilization and the printing of degassing channels for the pyrolysis, near net shape and complex CMC parts were obtained by the liquid silicon infiltration process (LSI). The thermal induced crosslinking step with a variation of temperature and dwell time was characterized by differential scanning calorimetry (DSC). The microstructure and the flexural strength of C/C-SiC material were studied and promising results obtained, e.g. the C-fibers were preserved during the whole LSI-process and a strength of almost 60 MPa was obtained.