Behavior of 3D printed plastics in high vacuum

Nikolas Vassilev

TTU Chemical Engineering and Chemistry

Additive manufacturing offers advantages for beamline experiments, including rapid prototyping, reduced costs, and customizable target support structures. However, the structure of 3D-printed plastics can trap air, which is gradually released under high vacuum (~10^{-6} Torr), leading to prolonged pump-down times. To assess vacuum compatibility, several commonly used plastics were evaluated by fitting pressure–time data to logistic functions and integrating these curves to quantify outgassing behavior. A consistent trend of improved vacuum performance was observed across all materials with repeated purging cycles using dry nitrogen. Integrated outgassing values were compared across plastics to rank their relative suitability for high vacuum environments. These rankings provide a basis for future comparisons, allowing other researchers to benchmark new materials against those tested in this study to determine their relative performance in vacuum applications.