Investigation of proton radiation damage effects on the tensile strength of 3D printed acrylonitrile butadiene styrene

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Materials providing radiation shielding in industry, are manufactured via traditional methods, but they can now be additively manufactured by modern advanced methods. Mechanical behavior of such additively manufactured materials are being studied to establish their physical properties. The acrylonitrile butadiene styrene (ABS) terpolymer is one of these materials that have been extensively studied by Howard University to understand the effect of fuse deposition modeling (FDM®) print parameters have on its mechanical properties. However, the effects of ionizing radiation on the mechanical properties of such 3D printed materials, like ABS, is just now beginning to be investigated. The purpose of this research is to understand the damage caused by space radiation on ABS parts manufactured by FDM® (FD-ABS) and how that radiation damage impacts the mechanical performance of FD-ABS parts in a simulated space radiation environment. The key components of this research include: (1) material characterization to investigate irradiation damage to FD-ABS parts caused by exposure to protons with energies up to 40 MeV and dose of 1 MGy; and (2) tensile experiments to investigate the ionizing radiation effects on the mechanical properties of the 3D printed ABS.