Electro-mechanical aging of 3D printed PLA conductive composites

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Key Words: *Additive manufacturing, Thermo-electro-mechanical coupling, Conductive composites*

Additive manufacturing (AM) techniques allow the manufacturing of complex-shape components with multifunctional composites. In this work, we conducted a comprehensive characterization of 3D printed PLA composites reinforced with Carbon Black through combined electrical, thermal and mechanical tests. These coupled behaviours were assessed attending to the influence of manufacturing and geometrical parameters such as printing orientation and sample length. Thus, we provided insights into how the printing process affects voids distribution and the subsequent impact on the thermo-electro-mechanical response of the material.

First, the thermo-electrical behaviour was studied by connecting the samples to a DC power source to heat them by Joule's effect. Then, the thermo-mechanical behaviour was studied by carrying out uniaxial tensile tests at different testing temperatures. Finally, the electro-mechanical aging of the material was studied by conducting uniaxial tensile tests to previously heated samples. The printing orientation is observed to be a key player in determining the material mesostructured (voids), suggesting a significant influence on the multifunctional response.

These results suggests that 3D printed conductive materials are ideal candidates for different applications such as smart metamaterial structures or sensor-actuator systems.

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