**Strategy to improve PLA-Cu-NP incorporation for the production of biocidal polymer composites**

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Copper nanoparticles (Cu-NP) are notably a strong candidate for biocidal components in composite materials for health and sanitary appliances. However, the microbiological properties of Cu-NP rely on the maintenance of the particles’ aspect ratio and their dispersion on the matrix [1]. Additional effort is required to incorporate polymeric materials due to the chain entanglement and increased viscosity in conventional extrusion processes.

This work is part of ongoing research about incorporating copper nanoparticles (Cu-NP) in polymeric matrixes to produce plastic filaments for Fused Filament Deposition (FFD) 3D printing. The Cu-NP were synthesized by an innovative approach and characterized by X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), and Ultraviolet-visible spectroscopy (UV-Vis) against samples from a conventional route. The obtained powders were mixed with poly(lactic acid) (PLA) pellets and further analyzed in SEM. The PLA polymer matrix was chosen for its biocompatibility, biodegradability, and widespread use in FFD 3D printing.

The obtained Cu-NP were shown as flakes of pure metal since no oxide peaks were found on the diffractogram [2]. The new synthesis route led to a sensible decrease in crystallite size, as estimated from the XRD data [1], and the spectroscopy indicated an improvement in particle dispersion [3].

The shape was related to the mechanical properties of copper, and the flakes proved beneficial for the incorporation with the PLA pellets due to the large surface area. These preliminary results show that it was possible to produce PLA pellets coated with a homogeneous and controlled layer of Cu-NP.

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References:

[1] TUNTUN, S. M. *et al.* Crystallographic characterization and application of copper doped hydroxyapatite as a biomaterial, New Journal of Chemistry, 47, 2874-2885 (2023).

[2] LIU, X. *et al.* Temperature-controlled self-assembled synthesis of CuO, Cu2O, and Cu nanoparticles through a single-precursor route. Materials science & engineering. A, Structural materials: properties, microstructure and processing,1–2, 7–14 (2007).

[3] XIONG, J. *et al.* Synthesis of highly stable dispersions of nanosized copper particles using L-ascorbic acid, 13, 900 – 904 (2011).