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CHARACTERISATION OF MECHANICAL PROPERTIES AND THERMAL CONDUCTIVITY OF PLA-COPPER COMPOSITES THROUGH 3D PRINTING

Keywords: Additive manufacturing, Polylactic acid – copper composite, material characterization

Additive manufacturing (AM) has demonstrated numerous benefits in the development and production of medical devices. Recent advances in AM have highlighted polylactic acid (PLA)-based metal composites as a promising area of research. In the present study, the mechanical properties and thermal conductivity of PLA-copper composites were investigated to determine their suitability for medical applications.

In this study, the test specimens were printed using the Fused Filament Fabrication (FFF) method with PLA-base copper containing filaments from two manufacturers, Protopasta (PP) and Formfutura (FF). The samples were subjected to mechanical tests, including tensile, three-point bending, Charpy impact and Shore D hardness measurements for five times in accordance with the ISO standards. Given that copper is an excellent thermal conductor, the thermal conductivity of the composites also investigated. Both composites were also compared to pure PLA.

The mechanical tests revealed that the two PLA-copper composites differed significantly in all the measured properties. The tensile strength of the pure PLA was 52.1 MPa ± 1.33 MPa, the PP Copper-filled composite was 38.8 MPa ± 0.25 MPa which is a significant decrease, but not as much as the FF Copper composite (15.4 MPa ± 0.17 MPa) which is only one third of the pure polymer. The thermal conductivity measurements showed that the tested PLA-copper composites had a thermal conductivity several times higher than pure PLA and were similar to each other.

PLA-metal composites in AM represent a relatively new area of interest in medical research. While PLA-copper composites have similar thermal conductivity their different mechanical properties suggest that they could be used in different medical solutions.

Acknowledgements

The research was performed in the 3D printing and Visualization Centre of the University of Pecs, Hungary, with the framework of Janos Bolyai Research Scholarship of the Hungarian Academy of Sciences (BO/00213/23) and National Research, Development and Innovation Fund of Hungary (TKP2021-NVA-06).