



Electrical properties of conductive polymers under stress

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Abstract (300 word limit)

Statement of the Problem: With the growing field of application of composites as replacements for hitherto metallic applications, the need for conductive polymers has increased. In fact, although composites can often replace metals with gains in weight, some applications require electrical conductive properties. Metallic films and grids have been envisaged and sometimes applied, but the High density of metals still impose a significant increase in weight. The use of electrically conductive polymers might provide an interesting solution, but there is scarce information about the electrical behavior of such polymers when included in structural members.

Additive manufacturing is a technology that enables the construction of graded materials. The specimens where built with layers in conductive PLA and regular PLA.

The purpose of this study is to describe the tests and results obtained when measuring the electrical conductivity of polymers under stress. Methodology & Theoretical Orientation: Electrical resistance of specimens was measured under different load conditions. The specimens were obtained by Fusion Deposition Modeling; since this process delivers non-isotropic parts, the influence of manufacture process parameters was also tested.

Specimens were tested for uniaxial and bending behavior.

Findings: A database of values of the electrical conductivity of the studied polymers was obtained and the influence of the manufacture parameters on this property was studied.

Key words: Conductive polymers, Fusion Deposition Modelling, Electrical properties under stress.

Image



Figure 1 – Example of uniaxial testing apparatus

Recent Publications (minimum 5)

1. Leigh, Simon J., et al. "A simple, low-cost conductive composite material for 3D printing of electronic sensors." PloS one 7.11 (2012): e49365.
2. Espalin, David, et al. "3D Printing multifunctionality: structures with electronics." The International Journal of Advanced Manufacturing Technology 72.5-8 (2014): 963-978.
3. Czyżewski, J., et al. "Rapid prototyping of electrically conductive components using 3D printing technology." Journal of Materials Processing Technology 209.12-13 (2009): 5281-5285.
4. Panda, Biranchi Narayan, et al. "A CAD-based approach for measuring volumetric error in layered manufacturing." Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science 231.13 (2017): 2398-2406.
5. Panda, Biranchi, et al. "Experimental and numerical modelling of mechanical properties of 3D printed honeycomb structures." Measurement 116 (2018): 495-506.

Biography

António Ribeiro is an Assistant Professor at the Mechanical Engineering Department of Instituto Superior Técnico, lecturing several courses in the Mechanical Design and Structural Materials Scientific Area. He has a PhD in Mechanical Vibrations from the University of Lisbon. His current main studies focus on holistic approaches to Engineering Design and Additive Manufacturing.

Marco Leite is an invited lecturer of the Mechanical Engineering Department at Instituto Superior Técnico and lectures the course on New Product Development at ISCTE Business School - IBS, both in Lisbon, Portugal. He also lectures courses on new product development at the executive level at INDEG-ISCTE. He received his PhD in the Engineering Design and Advanced Manufacturing focus area of the MIT Portugal program with a dissertation entitled: “Techno-Economic Evaluation in materials selection for multiple parts under OEM-Tier relations”. Since then, his research interests focus on methodologies for product development, namely with materials and process evaluation and selection, and on methodologies of design for additive manufacturing (DfAM).

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