Annotations of Doctoral Thesis Topics for Degree Course in ‘‘Nanotechnology and Advanced Materials’’

Topic: 3D printing of conductive polymer thermoplastic nanocomposites

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Annotation:

The dissertation will deal with the preparation and characterization of conductive polymer nanocomposites suitable for 3D printing. The student will focus on the selection of suitable carbon and metal nanofillers and their surface treatments in order to create a hybrid nanocomposite with a thermoplastic matrix in the form of granulate. This will be followed by filament preparation technology for 3D printing of products applicable in the electronics and automotive industries. Measurement of electrical properties (electrical conductivity) will be carried out in order to reduce both the value of the electrical percolation threshold and the cost of the final product. The shielding efficiency SE (dB) of these composites against electromagnetic waves will also be determined. Polymer nanocomposites will be designed to also serve as absorbers of electromagnetic radiation.

Requirements:

Knowledge of general and macromolecular chemistry and physics at university level. Good knowledge of the English, or a potential for improvement. Basic manual and laboratory skills. Ability to work independently.

Literature:

1. Michel Biron: Thermoplastics and Thermoplastic Composites 3rd Edition, William Andrew 2018, Plastics Design Library, ISBN: 9780081025017.

2. Usharani Rath and Pulak M Pandey: Investigations into the microwave shielding behavior of oriented Polycaprolactone/Carbonyl iron particles composites fabricated using magnetic field assisted extrusion 3D printing, Journal of Mechanical Engineering Science, 2020, pp. 1–14, DOI: 10.1177/0954406220959098

2. Wendy Triadji Nugroho, Yu Dong, Alokesh Pramanik: Composite Materials Manufacturing, Properties and Applications 2021, Chapter 4 - 3D printing composite materials: A comprehensive review, pp. 65-115, 2021

4. Cao M, Du C, Guo H, Li X, Song S, Tezel FH, Li B: Paving thermally conductive highway by 3D interconnected framework of carbon nanotube and graphene oxide in poly (vinylidene fluoride). Composites Part A: Applied Science and Manufacturing, 2018 (115), pp. 331–340, DOI: 10.1016/B978-0-12-820512-9.00013-7