



Nanodiamond Additives for 3D Printing

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Here we present the results of investigation intended to check the possibility of use nanodiamonds as reinforcing filler in thermoplastics for 3D-printing. To do that we produced filaments from Acrylonitrile Butadiene Styrene (ABS) and from ABS modified with nanodiamonds (ABS-ND) by extrusion and compared the features of manufacturing process and mechanical properties of produced filaments.

ABS was chosen for this experiment as a common thermoplastic polymer widely used in machinery, electronics, household and medical appliances and construction. At last time ABS has become the main material for rapid prototyping by extrusion-based 3D printers. Currently the wide use of this technology is restricted by the high cost of filaments mainly caused by a low productivity of their manufacturing process by extrusion. Therefore, the improvement of functional characteristics of ABS, increase in the productivity of the process and reducing manufacturing costs is an actual issue for material engineering.

It was found that ABS modification with 0.05 wt.% specially functionalized nanodiamonds has resulted in significant decrease in extrusion friction enabling to enhance the productivity of filament manufacturing by minimum 50 %; herewith, rotation force reduced by 24 % which can lead to energy saving and prolonged durability of tools.

Use nanodiamond additive in amount of 0.05 wt.% enhanced tensile strength and load of break of ABS by ≈ 14.5 % while stiffness and elastic modulus increased by 22.5 %; wherein, filament prolongation at break reduced by 94 %.

It is expected, that ABS modification by nanodiamonds performed during ABS pellets manufacturing will result in much higher homogeneity of nanodiamond distribution in polymer and better improvement of mechanical and thermal properties.

The company is looking for partners interested in the development of nanodiamond additive to thermoplastics and implementation of nanodiamond technology in 3D printing. The potential market is huge. If only 1 % of currently produced ABS will be modified with 0.05 wt. % of nanodiamonds, 50 ton nanodiamonds annually is required for this application, amount highly increasing current nanodiamond powder Global Market.