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Problems of materials science in additive technologies

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nanopowders, such as initial temperature required for oxidation and sintering or thermal effect during oxidation and sintering, need to be controlled. The ability to selectively change the described characteristics without changing the chemical composition of the initial material is very useful from a point of quality improvement for products made with the use of additive technologies at the stage of product body formation. It was found that thermal oxidizing effect was increased by ~2.5 kJ/g for aluminum nanopowder and reduced by ~0.2 kJ/g for iron nanopowder. At the same time, initial oxidation temperature increased by ~30 °C for iron nanopowder and kept the same for the aluminum nanopowder after electron beam irradiation. The integral value of the energy injected into the nanopowder was about 0.5 kJ/g. The difference between irradiation effects for Al nanopowders and Fe nanopowders can be explained by varying range of electrons (~190 μm for iron and ~280 μm for aluminum), which means different density of absorbed energy for nanopowders. This way, additional heating of iron nanopowders in comparison with aluminum ones allows for partial annealing of radiation-induced defects or high energy formation in the structure of a nanoparticle. As a summary, we can conclude that the irradiation of iron and aluminum nanopowders by pulsed electron beams makes them more suitable for 3D printing.

MOLECULAR DYNAMIC STUDY OF METAL SURFACE WETTABILITY BY NIOBIUM MOLTEN PARTICLE

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The need for production of implants with individual form leads to the necessity of developing new methods and approaches for their manufacture. The obvious advantages of additive technologies and selective laser sintering are the possibility of the formation of not only the external form of the product, but also its internal structure. When forming the structure, it is simultaneously possible to synthesize a new material, using a mixture of components in a desired ratio as initial powder. This paper studies the processes of the material surface wettability by liquid niobium during laser sintering by the method of computer simulation on the atomic scale. We have analyzed the effect of temperature of the liquid and the substrate and also the internal stress state of the metal layer on the features of the crystallization process dynamics of the investigated material fragment. The simulation results allow us to better understand the processes occurring during selective laser sintering of powders, and make recommendations for the definition of process parameters.

INKJET PRINTING OF ORGANIC SEMICONDUCTORS

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Synthesis of new semiconducting polymers determines the development of polymer organic electronics. Organic light-emitting diodes based on these polymers emit in a broad spectral range with high efficiency. Polymers have high film-forming properties and can be applied by different methods: centrifugation, inkjet printing, aerosol spraying, etc.

Functional polymer solutions for inkjet printing must conform to strict requirements on viscosity and surface tension. Therefore, the work reports about inks based on organic semiconductor polymer materials and investigation of their rheological characteristics. The viscosity of the ink solutions was measured by Brookfield viscometer, while the surface tension was determined by DSA25E (KRUSS) instrument for measuring the contact angle.

Furthermore, the solvent or mixture of solvents and the polymer affect the reproducibility of printing, must be thermodynamically stable and possess certain rheological properties.

It is also necessary to consider the speed of evaporation of the solvent or solvent mixture because it directly affects the morphology of the resulting film.

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