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Effect of "a cold" plasma on the nanostructure and properties of polymeric materials

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Abstract

Based on analysis of the current state of the production and use of synthetic materials focuses on the use of functional textiles and composite materials for various industries. Using the appropriate type of modification you can get a certain chemical reactivity of the material surface and ensure the completeness of the interaction of composites components.

Highlights the issue of application of electrophysical modification methods, such as radio frequency processes that are environmentally friendly, energy-saving and should be made, in practice, at room temperature. Flow of low-energy ions forming the plasma gas discharge in the test, which is a major factor affecting the surface of the material to be modified, allows to realize the process of changing the surface energy values of a number of synthetic materials, wherein the bulk mechanical properties of the modified material properties remain similar to the original material.

For experimental studies used a special high-frequency capacitive plasma installation with flat electrodes to implement the low-temperature plasma processes modifying the properties of synthetic materials, consisting of building blocks and elements.

With regard to target the problem of increasing adhesion activity ultrahigh molecular weight polyethylene fibers (UHMWPE) of different linear density optimized: discharge medium flow rate range of the plasma gas, the discharge power, the generator frequency and the residual pressure. For plasma discharges detected high-frequency capacitive discharge defining role and power discharge duration in order to increase the adhesion surface activity and obtaining UHMWPE fibers competitive reinforced polymeric plastics.

The structural characteristics of continuous multifilament UHMWPE – varying linear density fibers as a result of mechanical activation and processing in "a cold" plasma. It was found that the mechanical activation of the studied fibers discovered structural transitions in the modification of the gas discharge in an inert medium (argon) observed changes in their nanostructure heights uneven surface of the fibers, increasing the value of the capillary UHMWPE. FTIR spectroscopy revealed conformational changes that occur when you change the linear density of UHMWPE fibers as a result of mechanical action, by atomic force microscopy revealed changes in the surface of the nanostructure, determining the activity of material surfaces.

Thus, the research results show that the low pressure plasma high-frequency capacitive discharge allows activation of the surface of UHMWPE filaments to remove defective surface layers and, consequently, an increase in adhesive strength in composites.