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ВЛИЯНИЕ ТЕХНИЧЕСКОГО УГЛЕРОДА НА СТРУКТУРУ, МЕХАНИЧЕСКИЕ СВОЙСТВА И ЭЛЕКТРОПРОВОДНОСТЬ СМЕСИ СЭВА И ПЛА

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Развитие аддитивных технологий требует расширения ассортимента функциональных полимерных материалов для 3D-печати, среди которых высокий потенциал применения находят электропроводные композиты. В связи с этим актуальным вопросом является повышение электропроводности типичных для 3D-печати пластиков, в первую очередь полилактида.

Цель работы — изучить влияние электропроводной сажи на прочностные характеристики и электропроводность полимерных композитов на основе смеси полилактида (ПЛА) и сополимера этилена и винилацетата (СЭВА).

В рамках настоящего исследования получены полимерные смеси ПЛА и СЭВА, и композиты на их основе, наполненные электропроводной сажей. Ненаполненные смеси характеризуются структурой типа матрица–капля с инверсией дисперсной фазы и дисперсионной среды в диапазоне концентраций 45–65 об.%. Введение в полимерную смесь сажи способствует существенному улучшению равномерности распределения фаз при уменьшении размеров частиц смешанных полимеров. Существенной локализации сажи в одной их фаз не наблюдается, что приводит к формированию перколяционной сетки во всем объеме композита. Наименьшее сопротивление наблюдается в составах с соотношением полимеров 50/50, что, вероятно, связано с локализацией большей части сажи на границе раздела фаз, которая наиболее развита при близких значениях объемных концентраций полимеров.

Полученные композиционные материалы могут найти применение при создании прототипов элементов электроники, электростатической защиты и экранирования, энергетических систем и устройств хранения энергии методами 3D-печати.

Ключевые слова: полилактид, сополимер этилена с винилацетатом, электропроводная сажа, полимерные смеси, инверсия фаз, теплофизические свойства, удельное сопротивление.

EFFECT OF CARBON BLACK ON STRUCTURE, ELECTRICAL CONDUCTIVITY AND MECHANICAL PROPERTIES OF EVA AND PLA BLENDS

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The development of additive technologies requires expanding the range of functional polymer materials for 3D printing, among which electrically conductive composites have a high potential for application. In this regard, the increase of electrical conductivity of plastics typical for 3D printing, primarily polylactide, is an urgent issue.

The aim of this work is to investigate the effect of electrically conductive carbon black on the strength characteristics and electrical conductivity of polymer composites based on a blend of polylactide (PLA) and ethylene-vinyl acetate (EVA) copolymer.

In the present study, polymer blends of PLA and CEVA, and composites based on their blends, were filled with electrically conductive carbon black. The unfilled blends are characterized by a matrix-drop type structural morphology with inversion of disperse and disperse phases in the concentration range of 45–65 vol.%. The introduction of carbon black into the polymer blend contributes to a significant improvement in the uniformity of phase distribution while reducing the particle sizes of the blended polymers. No significant localization of carbon black in one of their phases is observed, which leads to the formation of percolation mesh in the whole volume of the composite. The lowest resistance is observed in compositions with the ratio of polymers 50/50, which is probably due to the localization of most of the soot at the interface, which is most developed at close values of volume concentrations of polymers.

The obtained composite materials can find application in the creation of prototypes of electronics elements, electrostatic protection and shielding, energy systems and energy storage devices by 3D printing methods.

Keywords: polylactide, ethylene-vinyl acetate copolymer, electrically conductive carbon black, polymer blends, phase inversion, thermophysical properties, resistivity.

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