

Electric and magnetic properties of composite materials in the polyethylene-nano-crystalline nickel system

L.S.Semko, V.M.Ogenko, S.L.Revo^{}, V.N.Mishchenko,
E.I.Oranskaya, N.N.Dashevsky^{*}, M.P.Semen'ko^{*}, K.O.Ivanenko^{*}*

Institute for Surface Chemistry, National Academy of Sciences of Ukraine,
17 General Naumov St., 03164 Kyiv, Ukraine

^{*}Department of Physics, T.Shevchenko Kyiv National University,
6 Acad. Glushkov Ave., 03022 Kyiv, Ukraine

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Polyethylene-nickel composite materials (CM) with nano-crystalline particle structure have been obtained. The variation regularities of structure, electric and magnetic properties of these materials as functions of Ni content have been studied in a wide concentration range. The expressions typical of percolation theory have been proposed to predict the the CM volume electric resistivity and the specific magnetization as functions of the nano-crystalline Ni content. The values of fractal dimensionality, D_{β} , of magnetic percolation cluster near the percolation threshold have been determined for the polyethylene-nano-crystalline Ni system.

Получены композиционные материалы (КМ) на основе полиэтилена и никеля с нанокристаллической структурой частиц. Изучены закономерности изменения структуры, электрических, магнитных свойств этих материалов при варьированном содержании Ni в широком диапазоне концентраций. Установлены выражения, типичные для теории перколяции, для прогнозирования значений удельного объёмного электрического сопротивления и удельной намагничиваемости КМ от содержания нанокристаллического Ni. Определены значения фрактальной размерности D_{β} магнитного перколяционного кластера вблизи порога перколяции в системе полиэтилен-нанокристаллический Ni.

At present, much attention is paid to obtaining and studying composite materials (CM) based on polymers and nanosized (including nano-crystalline) metallic particles [1, 2]. A great interest in these materials is due to their practical usage in recording elements of instruments, in high-density data recording devices, mini-sized sensors, and catalysts. To forecast electrical and magnetic properties of these CM, the data are necessary on their structure, processes growth of component cluster growth at the metallic powder concentration varying in wide ranges, as well as information on percolation phenomena in polymer-conductor systems (containing nano-crystalline parti-

cles). However, the regularities of structure and properties changes and the percolation effects in such systems are not studied adequately. Nevertheless, in these systems, sharp changes should be expected in electric, magnetic and optical properties in the percolation transition region.

The aim of the present study is to investigate the variation peculiarities of CM structure, electric and magnetic properties in the model polyethylene (PE)-nickel system with the nano-crystalline particle structure when the Ni content varies from 0 to 100 % mass (volume fraction (θ) 0 to 1). The novelty of the work consists in that the homogeneous materials of good prospects