Nanocomposites and nanomaterials

Stress sensitive polymer composites with oriented structure of filler phase

V.V. Levchenko[1], Ye.P. Mamunya[1], Yu.A. Klymenko[2], V.A. Yatsenko[2], M.V. Iurzhenko[1]

[1] *Institute of Macromolecular Chemistry, NAS of Ukraine, 48 Kharkivske Chaussee, 02160, Kyiv, Ukraine.*
E-mail: passwolf@ukr.net

[2] *Institute of Space Research of National Academy of Sciences of Ukraine and National Space Agency of Ukraine, 03187, Kyiv, Ukraine.*

Stress sensitive polymer materials are required in many areas of technical applications and can be widely used as the elements of electromechanical sensor devices of navigation and control (sensors of acceleration, sensors of pressure, etc.). Such materials change their resistivity under impact of applied stress. The most common type of stress sensitive material is a composite material with a non-conducting elastic polymer matrix containing conductive filler. In such composites the change of volume caused by applied external forces leads to change in electrical current that passes through the investigated composite material. Thus the properties of stress sensitive polymer composites mostly depend on the morphology of the filler phase. Oriented 1D structure of conductive phase which was obtained by treatment of the composites in a magnetic field was found to be extremely sensitive to the small values of applied stress and can be used for creation of stress sensitive polymer composites.

The composites based on silicone polymer filled with micro-size and nano-size Ni powders were investigated. The result of the treatment of the investigated composites in a magnetic field was the formation of anisotropic structures of nickel particles in a polymer matrix. The cyclic stresses were applied to the composites, the deformation and electrical current were measured along the loading cycles. The combination of micro and nano-size Ni particles was found to be effective filler for stress sensitive materials. When mixed, the nano particles have wrapped up micron particles thus prevented their sticking to each other during the deformation of the sample under applied stress and thus stabilized the system and increased the sensitivity of the composites. The results have shown high electrical sensibility of obtained composites with 1D structure of combined micro and nano-size fillers to the small values of applied stresses.