Riga Technical University

BALTIC POLYMER SYMPOSIUM

2009

Ventspils, Latvia

September 22-25

PROGRAMME AND PROCEEDINGS

Organised by

Institute of Polymer Materials, Riga Technical University

Institute of Polymer Mechanics, University of Latvia
Latvian State Institute of Wood Chemistry
Faculty of Chemistry, University of Latvia
Department of Chemistry, Latvian University of Agriculture

POLYCARBONATE NANOCOMPOSITES WITH MAGNETIC FILLERS: STRUCTURE AND PROPERTIES

S.Strode[1], A.Shutka[2], R.Merijs Meri[1], I.Zalite[3], A.K.Bledzki[4]

[1] Institute of Polymer Materials, Riga Technical University, Azenes str. 14/24, Riga, Latvia
[2] Institute of Silicate Materials, Riga Technical University, Azenes str. 14/24, Riga, Latvia
[3]Institute of Inorganic Chemistry, Riga Technical University, Miera str. 34, Salaspils, Latvia
[4] Institut für Werkstofftechnik, Kunstoff- und Recyclingtechnik, Kassel Universität, Mönchenberg St. 3., Kassel, Germany

Magnetic polymer nanocomposites have great application potential in many areas of national economy, such as: automotive industry, information technology (ferrite containing materials etc), medicine (hard and soft ferrite compounds for magnetic therapy, ferrite compounds for controlled drug release etc), packaging (magnetic materials for antifraud technologies etc), defence (materials for radar and satellite technologies) and in many other fields.

The applicability of magnetic polymer nanocomposites in these areas is largely determined by physical and chemical nature of their constituents as well as by their interaction level. Advantage from one hand should be given to conventional engineering thermoplastics, such as polycarbonate (PC), polyamides and others, due to their recyclability, relatively high thermal and mechanical resistance, low creep and sufficient toughness. From another hand nanocrystalline ferrites should be mentioned among most suitable materials for blending with polymers. Due to their nanodimensions, which in most cases are well below domain sizes, nanocrystalline ferrites possess specific properties, such as supermagnetism, macroscopic quantum tunnelling and others. Important prerequisite for obtaining economically feasible materials is also use of conventional and low-cost methods for both synthesis of ferrites and manufacturing of ferrite modified polymer composites.

Thus from the methods used for ferrite synthesis, in many cases advantages are given to various sol-gel routes, including auto-combustion synthesis, due to it technological simplicity, chemical homogeneity of the multi-component sol, microstructure control of the products etc. In respect of further processing of polymer-ferrite nanocomposites, preference should be assigned to melt processing technologies, such as extrusion, injection moulding, compression moulding and others.

In this investigation nanostructured magnetic filler modified PC composites are investigated. Nanostructured magnetic fillers were purchased ($Ni_{0,5}Zn_{0,5}Fe_2O_4$; $CoFe_2O_4$) and obtained by means of plasma treatment (material based on $Fe_2O_3(Fe_3O_4)$, SiO_2, CaO, Zn and other metal oxides) and sol-gel auto-combustion synthesis ($Ni_{0,5}Zn_{0,5}Fe_2O_4$; $CoFe_2O_4$; $BaFe_{12}O_{19}$). Most important technological parameters for the synthesis of the nanostructured ferrite fillers by sol-gel combustion synthesis were defined. Structure and certain physical characteristics of commercial and manufactured magnetic nanopowders were determined. Melt blending was applied to obtain polycarbonate based nanocomposites with various nanostructured filler weight contents: 2, 5, 10 %. Selected mechanical, rheological, thermal, calorimetric and magnetic characteristics of the manufactured nanocomposites were determined.

Results of the investigations show that certain mechanical properties, such as modulus of elasticity and stress at break, of the investigated PC based nanocomposites are significantly improved by addition of nanostructured ferrite filler. Additionally it was observed that ferrite nanofiller allowed increase certain magnetic characteristics, such as coercivity, magnetic induction, saturation magnetization, of the investigated composite materials. Electrical properties of the investigated systems however, were influenced to the lesser extent. Although our investigations on these types of materials are in their starting position and still much should be done, some possible application examples of such nanocomposites are materials used in electronics, housings for electromagnetic charge suppression and EMI shielding, as well as packaging for antifraud technologies.