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Polymer composite with soft magnetic Fe-Co nano-powders obtained by cavitation method

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Composite materials consisting of magnetic particles in polymer matrix have a wide area of potential application. In most cases the alloy nano-powders are obtained by means of polyol method or ball milling technique. These fabrication methods are characterized by low cost efficiency, but need multi-stage production process. In addition, the magnetic properties of obtained nano-powders do not strictly correspond to alloy state characteristics. In the present report the new cost effective method of nano-powder production is provided. It is the cavitation destruction that allows obtaining various magnetic nanoparticles with good magnetic properties close to those of well-known solid-state alloys. Cavitation is the process of formation and collapsing of low pressure bubbles near the surface of quickly moving object in a liquid. The collapse of tiny bubbles produces the intense shockwave that knocks out small particles from the object's surface into liquid. Resonance piezo-ceramic vibrator has been used in home-made laboratory facility to provide cavitation process. $Fe_{73}Co_{27}$ nanoparticles with very high saturation magnetization were obtained in different liquids such as benzyl alcohol, methyl methacrylate and water. Rather narrow particle size distributions not exceeded 18% were obtained in all liquids studied. It is found that the average particle size strictly depends on the liquid viscosity. It is given by 475 nm in methyl methacrylate, 196 nm in benzyl alcohol and 80 nm in water, respectively. Magnetic properties of 475 nm $Fe_{73}Co_{27}$ particles in polymeric matrix were investigated. In the fields of approximately 4 kOe composite were almost saturated, and full saturation was achieved in fields not exceeded 6 kOe. The highest saturation magnetization for this composite was equaled M_s=245.3 emu/g. Using cheap $Fe_{70}Co_{27}$ nano-powders with high saturation magnetization and small coercive force allows us to reduce the total amount of powder in polymer composite showing increased heating efficiency in alternating magnetic field. These magnetic particles are promising for biomedical applications, in particular, for hyperthermia treatment.

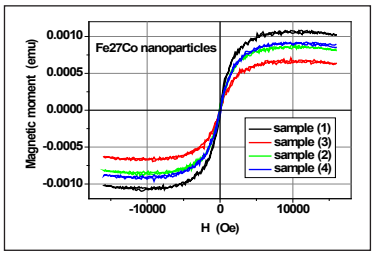

Figure-1: Hysteresis loops of the $Fe_{73}Co_{27}$ particles of 475 nm in size obtained in methyl metacrylate.

Biography

Kholodkov N S has completed his Master's degree in Material Science and Technologies from Moscow University of Steel and Alloys. He has worked in the field of magnetic measurements of weak magnetic fields produced by corrosion currents. Currently, he is a PhD student of NUST "MISiS" and is working with soft magnetic powders.

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