Synthesis, structure and magnetic properties of $Mn_xFe_{3-x}O_4$ (x = 0,1 – 0,6) for magnetorheological liquids

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Ferrimagnetic micro- and nanoparticles are used as a functional component of magnetorheological fluids (MRF) for magnetically controlled devices. When searching for such materials, high values of the specific magnetization of powders, low values of the coercive force, as well as a high value of shear stress in suspensions based on magnetic particles upon application of a magnetic field are important [1]. A series of powders of Mn-substituted magnetite $Mn_xFe_{3-x}O_4$ (x = 0.1 – 0.6) was synthesized by the method of coprecipitation from aqueous solutions of salts. Powder of composition $Mn_{0.3}Fe_{2.7}O_4$ showed high values of shear stress in magnetorheological suspensions. The particle size of the powder did not exceed 200 nm. It has been established that it is possible to change the magnetization and coercive force of powders by changing the degree of substitution, with the maximum magnetization corresponding to a powder of composition $Mn_{0.3}Fe_{2.7}O_4$. The high value of the shear stress (2 kPa) at a relatively low magnetic induction (~ 650 mT) allows the obtained material to be considered a promising functional filler for magnetorheological fluids (Fig.).

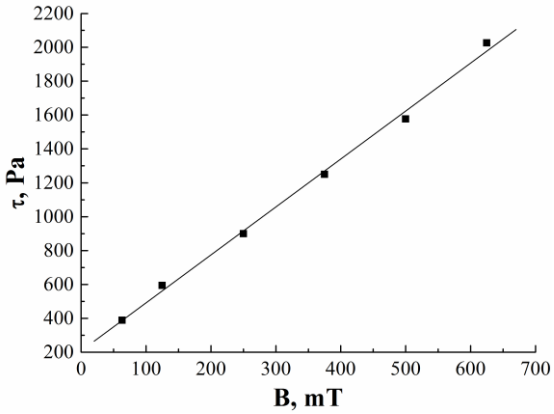

Fig. Dependence of the shear stress of the MRF containing 20 wt.% $Mn_{0.3}Fe_{2.7}O_4$ magnetic particles in Mobil 22 oil on the shear rate in a magnetic field at a shear rate of g = 200 s^{-1}, T = 20 ˚C

References

[1] Yu.S. Haiduk. Condensed Matter Interph. (2020) 22 (2) : 28.