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Minimization of electro-static forces in magnetic force microscopy for detection of single superparamagnetic iron oxide nanoparticles

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Superparamagnetic nanoparticles (SPNs) are of increasing interest in biomedicine. The wide range of applications, from diagnostic (Magnetic Resonance Imaging, MRI) to cancer-cells treatment (hyperthermia), promises an intensive use possibility. However, detection and characterization of SPNs at single particle level especially in biological samples remains a challenge. Therefore, techniques which can provide spatial distribution and magnetic properties of single magnetic nanoparticles are highly desirable. Magnetic Force Microscopy (MFM) can be used to detect and spatially localize single SPNs. However, arising magnetic signal from nanoparticles could be disturbed and covered by other existing forces. One of the strongest disturbing forces is the electro-static behaviour of the probes. Due to the conductivity of the MFM measuring tip, both, magnetic and electro-static, forces are detected simultaneously. In this work different approaches to minimize the electro-static interaction between probe and tip are discussed. We showed the possibility to reduce the electro-static force by choosing substrates with higher conductivity. Furthermore the electro-static behaviour can be reduced using Electrostatic Force Microscopy (EFM) and Kelvin Probe Force Microscopy (KPFM) combined with MFM. Those approaches are investigated to select the magnetic force and therefore allow MFM to serve as an excellent detecting technique which makes it possible to localize single magnetic nanoparticles on substrates, embedded in polymers and injected in biomaterial.

Biography

Alexander Krivcov is pursuing PhD at the University of Applied Sciences Kaiserslautern on the topic “Characterisation of superparamagnetic nanoparticles for biomedical applications with Magnetic Force Microscopy (MFM)”.

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