SCIENTIFIC RESEARCH EQUIPMENT, DESING AND MANUFACTURING

Electrospray deposition of superparamagnetic Fe_3O_4 isolated nanoparticles

M.Koeber, M.Luna, F.Briones and E. Hontañón*
Instituto de Microelectrónica de Madrid, c/ Isaac Newton 8, E-28760 Tres Cantos (Madrid) Spain
*RAMEM, SA., c/ Sambara 33, E-28027 Madrid, Spain E-mail: e.hontanon@ramem.com

Introduction

Fe_3O_4 superparamagnetic nanoparticles with a diameter below 10nm are of large interest for biosensors, medical diagnosis and NMR imaging techniques. In particular, superparamagnetic nanoparticles can be functionalized with DNA and are presently used as ultra-sensitive molecular imaging nanoprobes for the detection of complementary DNA. The detection mechanism is optical, employing a polarized light source which passes the solution containing the nanoparticles. If dimers are present (which will be caused by molecular recognition) the application of a magnetic field orthogonal to the direction of light propagation will lead to a well defined optical axis in the solution, in turn leading to a difference in light intensity of the passed polarized light with changing applied magnetic field. In the absence of complementary DNA a good dispersion (no aggregation) of the nanoparticles is important.

Experimental

Characterization of the nanoparticles in aqueous solution is essential to determine their size distribution and aggregation properties and is currently done by Transmission Electron Microscopy (TEM) and Atomic Force Microscopy (AFM) techniques. However, the sample preparation process for those techniques might influence the nanoparticle distribution and aggregation in the final images and therefore alternative techniques are needed. Electrospray is a good way to deposit nanoparticles and macromolecules because it avoids clustering and the deposition rate can be finally controlled.

Results

In this study the feasibility of using electrospray techniques to deposit magnetic nanoparticles directly from a diluted suspension in water is analyzed. A commercial electrospray source from RAMEM has been used to form ionized water nanodroplets of a dispersion containing nanoparticles. Those droplets evaporate in air and the isolated nanoparticles are directly collected on an ultraflat mica substrate without metallization or polarization of the substrate.

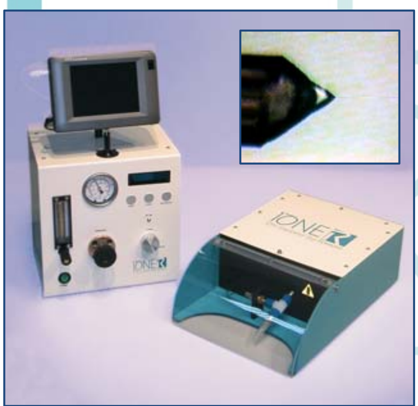

Image of the IONER® Electrospray source

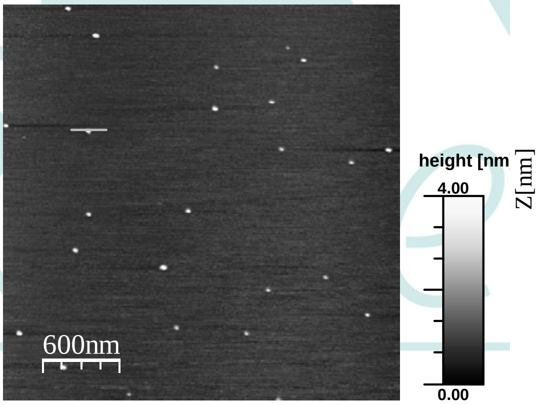

Figure 1. Fe_3O_4 superparamagnetic nanoparticles deposited by electrospray. The nanoparticles are dispersed homogeneously

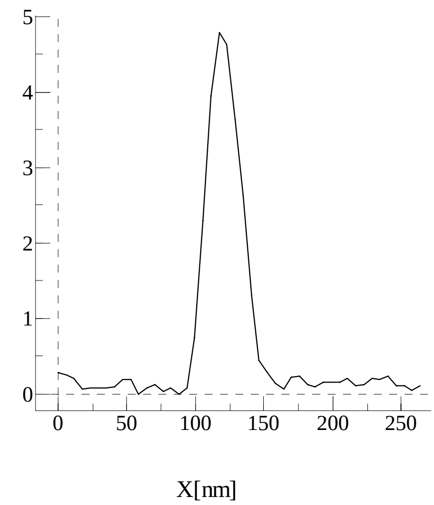

Figure 2 Profile of a nanoparticle. The width is determined by the AFM scanning tip, the height determines the diameter of the nanoparticle (particles are ball-shaped).

Next steps include increasing the deposition rate of the electrospray while avoiding clustering of the particles and testing the electrospray with biofunctionalized particles.

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Ramem s.a. Sambara 33 28027 Madrid Tel: (34) 91 404 45 75 Fax: (34) 91 403 45 96