Porous silicon with deposited iron oxide as vehicle for magnetically guided drug delivery

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Porous silicon as well as Fe_3O_4-nanoparticles are biocompatible [1, 2] and the solubility of porous silicon in body fluid depends on the porosity [3]. Thus the aim of this work was to create a superparamagnetic iron oxide/porous silicon nanocomposite applicable for magnetically guided drug delivery.

For this purpose Fe_3O_4-nanoparticles have been deposited or grown in porous silicon (figure 1). Both materials offer low toxicity and investigations concerning the cell-viability have been carried out. Since the system is intended to be employed for magnetically guided drug delivery the magnetic properties of the system have been optimized concerning the blocking temperature T_B and the magnetic moment which means that T_B has to be far below room temperature and the magnetic moment should be as high as possible. Due to the fact that T_B is not only dependent on the particle size (diameters between 4 and 10 nm have been investigated) but also on the magnetic interactions between the particles there are two main routes to fabricate such a composite with desired T_B. First a modification of the pore-loading with a concomitant variation of the distance between the particles within one pore and second a variation of the porous silicon morphology influencing the distance between particles within adjacent pores results in a variation of the blocking temperature. Figure 2 shows the dependence of the blocking temperature on the iron content of the employed Fe-salt solution which influences the inter-particle distance. To minimize magnetic coupling between the particles the filling factor has to be adjusted to the particle size (bigger particles need a greater distance). To ensure that there is no remanence after the external field has been switched off, magnetic coupling between the particles has to be kept sufficiently low.

A variation of magnetic inter-particle interactions - due to the deposition/growing procedures - with regard to the superparamagnetic behavior of the composite will be presented.

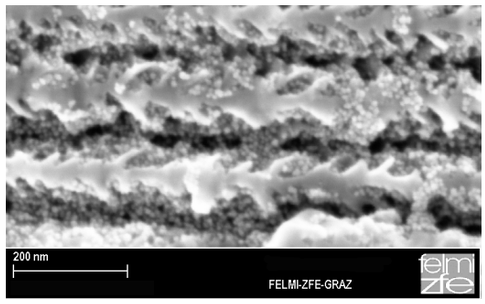

Figure 1: SEM image gained from backscattered electrons showing 8 nm iron oxide nanoparticles within the pores.

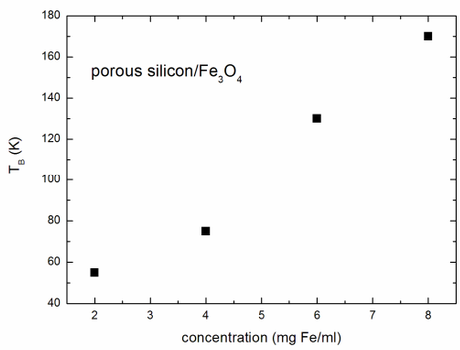

Figure 2: Dependence of the blocking temperature on the iron concentration of the used Fe-salt solution. T_B increases with increasing magnetic coupling (smaller inter-particle distance).

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