

**POLY(STYRENE-CO-VINYLBENZYLCHLORIDE-CO-DIVINYLBENZENE)  
COATED IRON OXIDE: SYNTHESIS AND EFFECTS ON SIZE AND  
MORPHOLOGY**

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Functionalization of magnetic nanoparticles is a key step for their integration into mainstream applications. This has been accomplished by several different methods ranging from simple chelating ligands to large polymer shells.[1-4] Polymer shells have a greater effect on particle size, but can offer more stability when compared to some chelating agents.[5] In this work, iron oxide nanoparticles are coated with poly(styrene-co-vinylbenzylchloride-co-divinylbenzene) that is formed by precipitation polymerization. The synthesis was carried out by similar methods used to produce poly(styrene-co-divinylbenzene) microspheres,[6] with the addition of iron oxide nanoparticles (0 – 5% by mass) to the monomer solution and the replacement of some styrene with vinylbenzylchloride. The addition of the chlorine to the polymer coating should increase hydrophilicity of the resultant particles and also open the possibility of further functionalization reactions. The iron oxide nanoparticles were synthesized by a polyol technique.[7-8] Powder x-ray diffraction confirmed the spinel structure for the iron oxide. Vibrating sample magnetometry yielded a saturation magnetization of 60 emu/g, thus suggesting maghemite ( $\gamma$ -Fe<sub>2</sub>O<sub>3</sub>).

As seen in Fig. 1, the resultant polymer microspheres without nanoparticles are fairly monodispersed with a diameter of 4  $\mu$ m. The addition of nanoparticles appears to decrease the size of the microspheres as well as increase the polydispersity as seen in Fig. 2. This trend is also seen to continue as you add more nanoparticles to the system going from 4  $\mu$ m with 0 % nanoparticles, down to below 1  $\mu$ m for 5 % nanoparticles. This indicates that the particles are not just incorporated into the polymer matrix, but act as nucleation sites to begin the polymerization process. The polymerization process was found to have no effect on the nanoparticles themselves as the magnetic characterization showed only a mass dilution in saturation when corrected by thermal gravimetric analysis.

**References:**

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**Figures:**

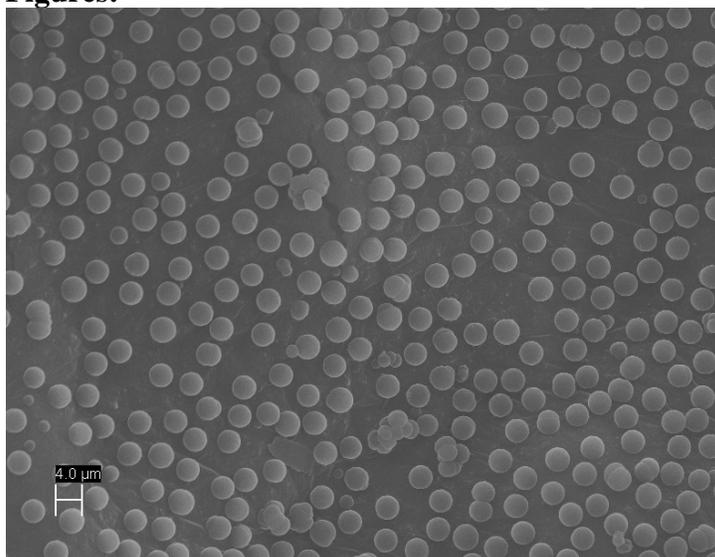


Fig. 1. Scanning electron microscopy image of PS-VBC-DVB microspheres without nanoparticle loading.

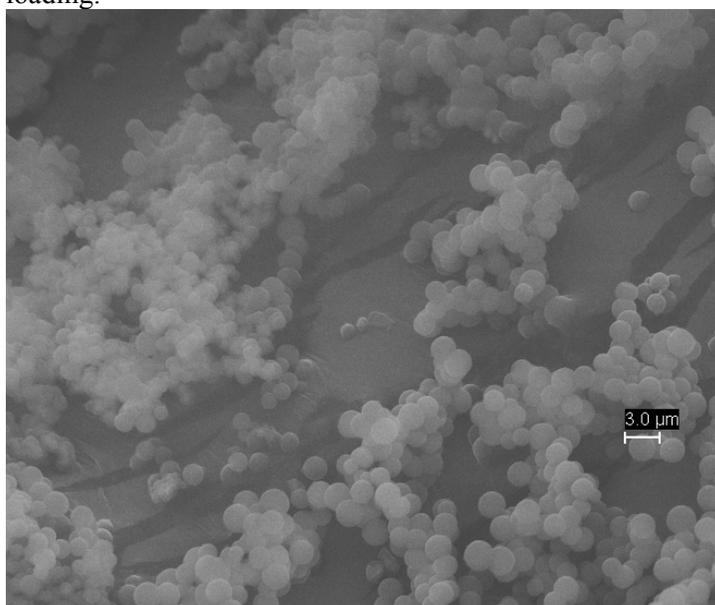


Fig. 2. Scanning electron microscopy image of PS-VBC-DVB with nanoparticles loaded at 1% by mass to the amount of monomer.