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Synthesis of Silica-Coated Iron Oxide Nanoparticles for Magnetic Resonance Contrast Enhancement and Thermal Therapies

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Superparamagnetic iron oxide nanoparticles are of interest for use as magnetic resonance imaging contrast agents and in thermal therapies. Silica nanoparticle coatings can increase the thermal stability of particles and provide a biologically inert surface for the attachment of functionalizing ligands. In this study, silica-coated magnetic iron oxide nanoparticles were produced by synthesizing core iron oxide nanoparticles in a thermal plasma followed by coating the particles with silica by photoinduced chemical vapor deposition (photo-CVD). Core particles were shown to be superparamagnetic with a maximum saturation magnetization of 29 emu/g. The photo-CVD process produced silica coatings with thicknesses up to 6 nm. Coatings were found to consist of conformal high-purity silica. The presence of the coating was found to decrease the saturation magnetization when evaluated on a total mass basis (iron oxide and silica).

Variations in Human Cardiac Vein Anatomies: Direct Mapping Within Fixed Hearts and Digital Reconstructions

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It is important to identify and understand variations in the anatomy of the human cardiac venous system in order to best develop and then use minimally invasive cardiac devices. Hence, anatomical mapping of the cardiac venous system of a large sampling of human heart specimens, with and without disease, will be a beneficial aid for cardiac device designers. We utilized fluoroscopy, a Microscribe 3Dx digitizer and IMAGEWARE software to obtain maps of the cardiac veins and to create 3D models. To date, we have created models for 19 perfusion fixed human hearts and will measure the anatomical parameters for each model. We have started and will continue to create a unique anatomical database for the major cardiac veins that will include vessel diameters, arc lengths, tortuousities, and branching angles from the coronary sinus. This novel database of cardiac venous anatomical parameters will allow one to better visualize and understand the degree of anatomical variability that exists between human hearts. We will continue to build this data set, which should be of great value for both device designers and those clinically implanting cardiac devices.

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