The Design and Synthesis of Multimodal Contrast Agents for Magnetic Resonance Imaging

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Imaging of biological systems and events by magnetic resonance imaging (MRI) has become a popular technique by offering a noninvasive way to image the spatial and temporal patterns in opaque subjects. Contrast agents are used in MRI to enhance the intrinsic differences in relaxation times within a sample. Fluorescence microscopy is another useful imaging technique because of its high resolution and sensitivity. Combining MR and optical imaging techniques is desirable due to the unique capabilities of each, thus contrast agents that are multimodal (both MR and optically active) are advantageous. Such agents will potentially offer co-registration and histological validation in cell migration, patterning, recognition and fate mapping studies.

The objective of this research is to design and synthesize multimodal contrast agents that are MR and optically active. We describe the syntheses of several new multimodal agents that utilize biocompatible T_2-enhancing iron oxide nanoparticles conjugated with fluorophores. Current research with these agents focuses on the *in vivo* cell patterning, recognition, and behavior of these materials. Initial results indicate the agents are taken up by cells in ~24 hours. In order to facilitate this uptake, the attachment of several transport molecules is underway. Additionally, the synthesis of a new generation of multimodal contrast agents is currently being investigated in which the agents will have two MR modalities and one optical modality. The agents will provide knowledge about the physical characteristics and behavior of the interactions between a T_1 and a T_2 agent. Physical properties such as the core size of the T_2 agent and the optimal T_1:T_2 ratio are being examined.