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Colloidal systems for smarter cancer imaging and adaptive therapy

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Imaging is a fundamental tool in the practice of medicine. The interaction of medical imaging radiation with new materials has long been exploited to develop new and improved imaging systems and techniques. In parallel with these advances, there is increasing interest in developing new contrast agents for the diagnosis of disease. Exogenous contrast agents are non-native sources of contrast that differentially scatter, absorb, or emit medical imaging radiation (e.g., sound waves for ultrasound imaging, radiofrequency waves for magnetic resonance imaging, near IR light for photoacoustic imaging, and x-rays for computed tomography and mammography) as compared to surrounding tissues and inherent background noise such that their location can be tracked upon introduction into a patient.

At the forefront of new contrast agent development are new, clinically-relevant, colloidal materials that can be activated by medical imaging radiation external to the patient and under image guidance, to characterize and treat cancer. Since the contrast agents' *in vivo* distribution and interaction with radiation are strongly size- and material-dependent, a new opportunity in materials science is the creation of new colloidal systems that can be tailored for specific contrast imaging and with therapeutic properties.

This talk will focus on the development of new contrast agents that can facilitate more focused and targeted delivery of cancer therapies to tumours for higher therapeutic ratios, and can permit the treatment of hard-to-access organs like the brain in a minimally-invasive manner. Specific examples of different hierarchical and composite contrast agents that are assembled to address and balance biological and physical challenges of contrast agent development will be given, with a focus on the use of perfluorocarbon bubbles, droplets and nanoparticles as multifunctional contrast agents for ultrasound imaging and therapy applications.

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