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Latest Developments in Dynamic MRI of Multi-Phase Systems

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In recent years there has been increasing interest in applying magnetic resonance techniques in areas of engineering and chemical technology. Central to many engineering applications is the need to characterise both hydrodynamics and chemical reaction in optically opaque three-dimensional environments; thus MRI is uniquely well-suited to such studies. This presentation addresses the application of MRI techniques which have sufficiently fast data acquisition times that unsteady state processes can be imaged. The presentation will take as a theme the imaging of physical and chemical phenomena occurring within heterogeneous catalytic reactors - these systems are, typically, packings of catalytically active particles through which gas and liquid flow causing chemical conversion as the reactants interact with the surface of the catalyst. The overall aim of our work is to use MRI to provide information such that we can understand the coupling of hydrodynamics and chemical kinetics in complex porous structures. Two particular areas will be addressed: ultra-fast MRI for studying hydrodynamics, with typical data acquisition times of 10-20 ms for a 2D velocity image, and polarisation enhancement techniques for chemical mapping.