Spatially-Resolved Magnetic Resonance: More Than Just a Camera

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As in any research field, 'timing' plays a huge role in the opportunities we have and the research directions we take - particularly when you are starting a research group. In my case, the lucky 'timing' was in being hired in a chemical engineering department at much the same time as the early availability of commercial magnetic resonance spectrometers equipped with the hardware and basic software to do both chemical spectroscopy and diffusion/flow measurements, and with the ability to obtain spatial resolution in these measurements. This lecture will reflect on how spatially-resolved magnetic resonance has become increasingly useful in advancing our understanding of the physical and chemical processes that play important roles in the performance of many chemical technologies.

The motivation for the group's work has always been to *understand* the physics and chemistry underpinning the performance of a given application. Can we use magnetic resonance to remove bottlenecks in our understanding as we move from the basic science on which a technology is based through to the implementation of that technology? The questions that we seek answers to drive the development and implementation of new magnetic resonance methods in the group.

The lecture will include examples of some of the major themes of our activities over the years:

- Sorbents and catalysts: The importance of heterogeneity
- Three-dimensional structure and flow imaging: Measuring quantities that had never previously been measured
- The ability to measure unsteady-state behaviour: Undersampling, compressed sensing and Bayesian approaches
- *Operando* spatially-resolved magnetic resonance: Measurements at process operating conditions

Most importantly, this lecture is an opportunity to celebrate the work undertaken by all the research students, post-doctoral researchers and academic colleagues who have worked in the group, and the friendship of so many senior academics around the world.