Sensitizing Solid-State NMR Spectroscopy for the Atomic Level Characterization of Surfaces

The atomic level characterization of surfaces and interfaces remains an unanswered scientific challenge. Solid-state nuclear magnetic resonance (NMR) spectroscopy could be an ideal probe of atomic level structure since it can be applied to both ordered and disordered materials. Solid-state NMR spectroscopy also offers unparalleled selectivity. It is possible to selectively detect signals from surfaces and interfaces, or perform spectral editing on the basis of spin couplings. However, NMR spectroscopy suffers from intrinsically poor sensitivity that limits or prevents its application, as is the case when the species of interest are very dilute, relaxation times are unfavorable, the nuclei under study are unreceptive, or other mechanisms reduce sensitivity. In this talk I will describe how the state of the art NMR technologies of fast magic angle spinning (MAS) or dynamic nuclear polarization (DNP) can be used to enhance the sensitivity of solid-state NMR experiments by orders of magnitude. I will give examples of how these techniques enable the characterization of semiconductor nanoparticles and heterogeneous catalysts.