Imaging the Brain with Paramagnetic Nanoparticles

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Treatments and diagnoses are severely limited by our inability to visualise the biochemical processes underlying disease. Nowhere is this issue more limited than in the brain, due to the high level of complexity and presence of the blood-brain barrier. Our ability to disease processes is often limited to fluorescence or histological methods, largely limited to *in vitro* models that struggle to replicate the complex environment found in the body or *ex vivo* snapshots that capture a single moment of time. New approaches are needed that combine biochemically specific *in vivo* real-time imaging with *in vitro* and *ex vivo* approaches.

Our efforts are focused on the design and application on novel contrast agents for magnetic resonance imaging of the brain. Key applications include detection of key neuroinflammatory biomarkers, tracking drug delivery, and targeted agents for studying neurodegeneration. Our approach involves using the paramagnetic properties of lanthanides and transition metals incorporated in nanomaterials for use as MRI contrast agents, with applications in a variety of *in vitro*, *ex vivo*, and *in vivo* models. We are particularly focused on the use of multimodal imaging and spectroscopy approaches. Through this combinatorial imaging approach, we aim to use novel bioinorganic and materials chemistry to deepen understanding of biological processes across length scales - from subcellular to whole organ levels.

[1] Sedgwick et al, *Chem. Soc. Rev.* **2020**, *49*, 2886-2915.
[2] Wei et al, *PNAS* **2021,** *118*, e2102340118.