Imaging is of key importance in modern medicine. For example, in vitro, fluorescent tags can be used to probe the biodistribution in cellular systems, and in vivo, MRI scanning provides effective images of soft tissue which can assist in the diagnosis of tumours. In many cases, targeting of the imaging agent can be a significant challenge, with covalent modification of the fluorescent label being employed. One of the best ways of directing an imaging agent is to design it in such a way that it can form high-affinity interactions with its target – in general terms, using many so-called multivalent supramolecular interactions can lead to higher affinity binding.[1]

In recent years, we have developed expertise in the development of a new approach to multivalent systems, in which we self-assemble individual molecular scale building blocks into larger structures capable of then displaying multivalent arrays of ligands on their surfaces. We refer to this approach as SAMul (self-assembled multivalency)[2] and have demonstrated that this strategy can give rise to high-affinity interactions under biologically relevant conditions.[3]

In this new project, we aim to exploit the interior of these vehicles as carriers for imaging agents. In this way, the SAMul system will facilitate the transport of the imaging agent to the target cells/organ. We will probe the assembly of these carrier vehicles using a wide range of different techniques, including dynamic light scattering and spectroscopic assays. We will aim to use fluorescent probes in vitro to image specific proteins on cell surfaces. Using magnetic resonance techniques we will explore the effect of encapsulation on contrast agents, and aim to develop systems which could localise within specific tissues/organs for more effective imaging in vivo. Furthermore, by also including therapeutic agents (e.g. anticancer agents or antibiotics) within the SAMul nanostructures, we should be able to achieve theranostics,4 in which diagnostic imaging can be combined in a single nanoscale carrier device agent with a therapeutic outcome.

This project, in the strategically important area of nanoscience, will allow you to develop expertise at the critical interface between chemistry, biology and medicine and provides ideal training across a broad range of techniques – from chemical synthesis to biological assays. In this way, the project provides multi-disciplinary training and, in its later stages, the opportunity to collaborate with biologists and NMR/MRI specialists. You will be joining a vibrant multinational team of researchers in a well-equipped laboratory and should expect to demonstrate team-working ability as well as driving forward your own project through individual innovation.