Using Fluoroaromatics as Probes of Small Molecule Self-Aggregation

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The self-association of small molecules has impact across a wide range of fields, from drug delivery and storage to liquid crystals and supramolecular chemistry. Small molecules are often used as probes of aggregation, for example the use of a thioflavin T fluorescence assay to monitor amyloid fibril formation, or are themselves incorporated into larger assemblies such as gas storage in metal-organic frameworks.

Recently, using the azo-dye sunset yellow FCF as a model system which shows concentration-dependent self-association [1], we have investigated the use of small fluoroaromatics as probes of this aggregation process [2]. We chose these molecules as they have similar structures to portions of sunset yellow and hence should interact with the assemblies without causing any significant disruption. The inclusion of a unique ¹⁹F atom allows an NMR measurement which is background-free, i.e. there are no signals observed from the assemblies, just the probe molecules. The probe molecules chosen are the structure isomers of fluorophenol and two isomers of fluoronaphthoic acid.

We have utilised a combination of careful chemical shift and diffusion coefficient measurements to investigation the addition of the small molecule probes, initially at a low concentration of 1 mol%, to samples of sunset yellow [2,3]. Using a combination of chemical shift and diffusion coefficient measurements we can describe two binding modes for the probe: one to the ends of the sunset yellow stacks and a second for incorporation into the stacks [2,3].

In this poster we expand on this work to include the probe species at higher relative concentrations. It appears that the binding of fluorophenol to sunset yellow aggregates is largely independent of concentration, although minor variations are seen at very high relative concentrations. We also investigate the role of fluorine atom incorporation and isomerism on the self-association of the naphthoic acid probe species themselves.