Harry Anderson’s research group at Oxford University is exploring the synthesis and behaviour of porphyrin-based molecular wires for a wide range of applications. Porphyrins are large flat aromatic molecules which occur widely in biology — they are the dyes that make blood red and grass green. We make molecular wires by linking these molecules together in such a way that electrons can easily move between the individual porphyrin units.

Part of this project is concerned with measuring how quickly electrons move through porphyrin-based wires. This work involves synthesising wires with electron-acceptors at one end and electron donors at the other end; we then measure the rate of photoinduced electron transfer through the wire, as a function of the length of the wire. The Mass Spectrometry Service at Swansea has provided crucial help in characterising these synthetic structures.

One of the remarkable properties of porphyrin based molecular wires is their ability to absorb two photons of light simultaneously. They have extremely high two-photon cross sections. This has many applications. For example it can be used to protect delicate sensors from intense light, in a process known as optical power limiting.

We are also investigating medical applications of two-photon absorption in photodynamic therapy. Here the porphyrin dimer is used as a drug. When it is excited inside a living cell, its excited state is able to convert ordinary molecular oxygen into excited-state singlet oxygen, which then kills the cell. The amount of two-photon absorption depends on the square of the light intensity, so the effect can be pin-pointed to regions of very high light intensity. We hope that these porphyrin based molecular wires might eventually be used to treat eye diseases such as age-related macular degeneration.

FAB and MALDI mass spectrometry are vital techniques for characterising these metalloporphyrins and porphyrin oligomers; mass spec often provides the first reliable indication of a successful synthesis, and it can be the only way of establishing, for example, that a particular compound is a dimer rather than a trimer.

**Publications:**


Examples of optoelectronic materials under investigation: