Luminescence shines new light on proteins

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A chance discovery by a team of scientists using optical probes means that changes in cells in the human body could now be seen in a completely different light.

Prof David Parker from Durham University's Chemistry Department was working with experts from Glasgow University, and a team of international researchers, when they discovered dramatic changes in the way that light was emitted by optical probes during a series of experiments.

Light has energy and carries information and the researchers used the optical probes to measure the behaviour of light and its interaction with proteins abundant in human blood. The fortuitous discovery has led to the creation of a new type of probe for examining protein interactions that could be used for cellular imaging.

By tracking the way in which proteins bind, the experiments will aid understanding of the function of the most abundant protein in the body, serum albumin. In the future the technique could help to understand how drugs used in medicine interact with the major protein found in blood.

Prof Parker says: "It's a new step in the development of optical probes in chemistry and in observing the interaction between medical drugs and proteins."

The Durham University-led team looked at how light behaved when serum albumin was added to the probes and found that the emitted

polarised light had interesting characteristics.

Chirality, or handedness, is a key concept in Nature. In molecular chemistry, it refers to the concept of a molecule having two mirror images that cannot be superimposed onto each other; these are called enantiomers and pairs of these can be designated as 'right-' and 'left-handed.'

Light can be thought of as being made up of two left and right handed components and this property can be measured. The research team used optical probes with hi-spatial resolution and precision to track protein interactions and to see how the light rotates and inverts when passed through the proteins.

Prof Parker says: "We have found a way to use the inherent chirality of light to examine the interaction at the molecular level between a probe (the optical probe, itself of one handedness) and serum albumin (also of one handedness: hence akin to a hand/glove interaction) - the most abundant protein in blood."

Based on a chiral lanthanide complex, the probe emits circularly polarised light that inverts sign on protein binding; monitoring the emitted light allows researchers to follow the interaction between the complex and the protein.

Observing this luminescence is a way of studying the chirality of the system, explains Prof Parker: "The optical signal we observed carries information in its circular polarisation. It's a tricky process. You have to get the light in and out of the cells but crucially, in terms of biology, it can be done using microscopes in the laboratory so it's non-invasive."

The researchers found that only one enantiomer of certain europium and terbium complexes bound selectively to a drug binding site of the protein

serum albumin, and that the luminescence changed dramatically. Prof Parker says: "This is the first example of chiral inversion using an emissive probe in this way."

The researchers have been seeking to develop responsive optical probes for a while and were delighted when they finally cracked it.

Prof Parker said: "We were genuinely surprised. The binding energy and kinetics have to be just right - we've been lucky. Potentially this technology could be used to track protein association in living cells in real time."

Source: Durham University