Chiral metamaterials for ultrasensitive biodetection

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Abstract

We discuss the effects of chiral molecular materials on the optical properties of plasmonic materials, and the subsequent application is biodetection, Specifically we demonstrate the the EM field in the vicinity of chiral nanostructures can be engineered for enhanced performance in biophysical measurements.

We have developed a new paradigm for the spectrosocpic characterisation of the structure of molecular materials. We have significantly enhanced the capabilities of a spectroscopic measurement by using "sculpted" electromagnetic (EM) fields created using plasmonic nanomaterials. I will present proof of principle results [1], in which we demonstrate ultrasensitive (picogram) detection and characterisation of protein secondary structure; this level of sensitivity is a million times greater than is achieved by previously known spectroscopic phenomena. In recent work we have gone further than just amplifying sensitivity, and I'll show that sculpted EM fields, applied in a technique we have named superpolarimetry, can be used to characterise an order of hierarchical structure of (bio)materials that is inaccessible with known spectroscopic phenomena, and can currently only be probed with microscopy. I'll also discuss recent improvements in our understanding of the optical properties of hybrid chiral molecular – plasmonic material [2].

References

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[2] N. A. Abdulrahman, Z. Fan, T. Tonooka, S. M. Kelly, N. Gadegaard, E. Hendry, A. O. Govorov, and M. Kadodwala, Nano Letters 12 977 (2012)

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