Molecular Chirality Detection Technique using Hybrid Plasmonic Substrates

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Technology description

System offers low-cost methods for efficiently and accurately detecting low levels of left- and right-handed enantiomers of drugs seeking FDA approval

University of Central Florida researchers have designed a system that can accurately identify the chirality of drugs, proteins, DNA and other molecules at lower detection limits than conventional detection systems. With the ability to generate and use superchiral light, the new technology enables pharmaceutical companies to identify both enantiomers (right- and left-hand versions) of a chiral molecule embedded on a single achiral substrate made from a much smaller sample size than is typically used in current detection methods (picograms versus milligrams).

Pharmacological and toxicological characterization of chiral molecules plays a crucial role in the Food and Drug Administration approval process since some enantiomers can cause toxic or severe side effects. By enabling scientists to study in real-time, protein folding and misfolding, the UCF system may also help in the early detection and treatment of diseases such as Alzheimer’ s, Parkinson's and diabetes .

Technical Details

The invention is a molecular chirality detection scheme for identifying both left- and right-handed versions of chiral molecules. It includes methods for fabricating a single nanostructured substrate faster and more cost-effectively than other systems and illuminating the substrate with circularly polarized light (CPL) to induce chiral light-matter interactions. In one example application , the substrate is an array of hole-disks, each coupled with an asymmetric optical cavity and a back reflector. The substrate is created using low-cost, high-quality, large-area nanoimprinting techniques. A Fourier transform infrared instrument (FTIR) is used to illuminate the unique cavity-coupled achiral plasmonic metasurface with CPL.

The light-matter interaction generates superchiral light, which induces strong chiral near-fields on the upper surface exposed to the target analyte. The capability allows increased interaction with the analyte. Also, the achiral symmetry of the plasmonic substrate suppresses the circular dichroism of the substrate itself, ensuring almost no background noise and allowing the detection of pure chiral signals from the molecule. By controlling excitation conditions, scientists can achieve nearly 100 percent right-polarized or left-polarized chiral near-fields on the same substrate. Since the cavity straightforwardly

tunes the chiral plasmonic resonance, a wide range of chiral molecules with various absorption bands may be probed based on the same nanostructure.

Application area

Possible add-on to commercially available Fourier transform infrared (FTIR) instruments
Identification of the enantiomeric concentration of synthesized drugs to comply with FDA approval levels
Early-stage disease detection (such as Alzheimer’ s, diabetes)

Advantages

Provides pure background-free molecular chirality through near-field light-matter interaction
Can enable four orders of magnitude higher detection limits than conventional techniques
Allows scientists to identify both enantiomers of a racemate on a single substrate
Accommodates testing of a wide range of chiral molecules (with varied absorption bands) on a single substrate

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