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System for Dark-Field and Confocal Circular Dichroism Spectroscopy

Dark-field/confocal CD spectroscopy isolates or suppresses surface-specific chiral signals, expanding molecular chirality analysis beyond solutions.

Researchers at Purdue University have developed a system that implements dark-field detection geometry to selectively isolate low-angled scattered signals in circulation dichroism (CD) spectroscopy. CD spectroscopy is widely used to characterize secondary structure in biomolecules and precisely determine chiral configurations in small molecules. This technique has become an integral component of research methodologies across several scientific disciplines. However, the theoretical underpinnings for CD measurements of surface-bound assemblies are arguably less developed. For scattering samples oriented at surfaces, much larger chiral-specific CD signatures are accessible, connected to molecular structure through mechanisms unique from and complementary to traditional CD spectroscopy of solutions. Separate isolation of the coherent and incoherent contributions is critical, either to access this new information or to selectively suppress it as an interference in conventional CD spectroscopy.

This novel dark-field absorbance adaptation for CD spectroscopy provides commercial CD spectrometer manufacturers with a viable tool capable of harnessing chiral-specific and interface-specific CD spectroscopic observables. This technology enables the selective detection of low-angle scattering in uniaxially oriented molecular assemblies via a custom "dark-field" sample chamber. Complementary confocal CD spectroscopy measurements selectively suppress potential interferences from such scattering contributions in experiments designed to recover the isotropic response. Moreover, this dark-field/confocal CD spectroscopy combination will engender new opportunities for interpreting chirality for surface assemblies, which routinely arise in biological analyses.

Technology Validation:

Oriented microcrystalline thin films were deposited dropwise from a saturated toluene solution onto prepared hydrophilic fused silica slide

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Category

Biotechnology & Life Sciences/Biomarker Discovery & Diagnostics
Biotechnology & Life Sciences/Analytical & Diagnostic Instrumentation
Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

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surfaces. The spectra exhibited 5- to 10-fold enhancements in the nonreciprocal (sample orientation-dependent) CD activity when measured in a dark-field configuration, and a corresponding suppression of the nonreciprocal CD when measured in a confocal configuration.

Advantages:

-Selectively isolates or removes non-reciprocal chiral-specific observables from surface assemblies that are much greater in magnitude than corresponding reciprocal, isotropic contributions

-Enables new spectroscopic insights into molecular and macromolecular arrangements with both interface-selectivity and chiral-specificity

-Supports complementary suppression of interferences from oriented surface assemblies

-Implemented on commercially available, conventional CD spectrometer

Applications:

-Thin chiral film analysis

-Sensor surfaces for biosensors

-Polymeric materials analysis by spin-casting

-Pharmaceutical materials characterization

TRL: 3

Intellectual Property:

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