Docket #: S19-427

Optical Method to Separate UV-Resonant Chiral Compounds and Detect Solution Enantiopurity

Stanford inventors have developed a nanophotonic platform for detection and separation of chiral compounds that absorb in the ultraviolet regime.

Many otherwise useful chemicals in the pharmaceutical and agrochemical industries are limited in their application because their synthesis produces a mixture of left- and right-handed chiral molecules (enantiomers) that function in distinct ways. Chiral spectroscopy based on differential absorption of circularly polarized light (CPL) is a method that can help separate these closely related molecules, but the effect is generally too weak for efficient separation or sensitive detection. Nanophotonic platforms can enhance the effect by increasing the local density of optical chirality of the circularly polarized light, but metasurfaces that operate in the ultraviolet spectrum are lacking.

Scientists in the Dionne group have developed a high quality factor diamond metasurface that concentrates the local density of optical chirality up to 1130-fold to allow sensitive detection of enantiomeric molecules with CPL and enables efficient separation with a chiral column. This optical platform is optimized for detection and separation of molecules that absorb in the ultraviolet regime, making it ideal for many pharmaceutical and agrochemicals and most amino acids.

Applications

- Chiral molecule separation for the pharmaceutical and agrochemical industries, including production of compounds like naproxen, citalopram, salbutamol, ibuprofen, ephedrine, etc.
- Chiral molecule detection for enantiopurity assessment

- Diagnosis of diseases characterized by the presence of opposite-handed D-amino acids, like Alzheimer's, Parkinson's, and kidney disease.

Advantages

- Improvements in local density of optical chirality of >1110-fold
- Applicable to a wider range of chemicals due to operation in UV regime
- More versatile than chemical methods of separation since unique substrate not required for each molecule-of-interest
- Low background due to achiral nature of platform

Publications

- Hu, J., Lawrence, M., & Dionne, J. A. (2019). High quality factor dielectric metasurfaces for ultraviolet circular dichroism spectroscopy. ACS Photonics, 7(1), 36-42.
- Solomon, M. L., Abendroth, J. M., Poulikakos, L. V., Hu, J., & Dionne, J. A. (2020). Fluorescence-detected circular dichroism of a chiral molecular monolayer with dielectric metasurfaces. *Journal of the American Chemical Society,* 142(43), 18304-18309.
- Solomon, M. L., Saleh, A. A., Poulikakos, L. V., Abendroth, J. M., Tadesse, L. F., & Dionne, J. A. (2020). Nanophotonic platforms for chiral sensing and separation. *Accounts of Chemical Research,* 53(3), 588-598.

Patents

- Published Application: WO2021092526
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