量子物理学・ナノサイエンス第 122 回特別セミナー

Differential Absorption of Circularly Polarized Light by Noncentrosymmetric Racemates and Centrosymmetric Crystals

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場所　：　南 5 号館 1 階 103B 第 2 会議室

概　要

Racemates have been assumed to be optically inactive for the last 170 years. The cancelation of opposite rotations from left- and right-handed enantiomers (racemates) was discussed by Pasteur for tartaric acids and has never been dismissed. However, Pasteur opened a question: “En est-il toujours ainsi? C’est à l’expérience de répondre”, which could be translated as “Is it always true? The experiments should tell us”.

Specific arrangements of racemic units, however, can lead to optical activity, and as many as one in twenty racemic compounds are potential optically active materials. These form an important and often overlooked class of noncentrosymmetric structures with broken inversion symmetry. This talk is based in part on a paper that we published several years ago with the title “Machine-learning-assisted Synthesis of Polar Racemates,” that describes our efforts to synthesize other new members of a peculiar class of noncentrosymmetric (NCS) materials (crystal class mm2, space group $Pna2_1$) first reported in “From Racemic Units to Polar Materials,” R. Gautier *et al*., Cryst. Growth Des., **12**, 6267–6271 (2012).

Crystalline solids in general are governed by universal structure-property relationships derived from their crystal symmetry, leading to paradigmatic rules on what properties they can and cannot exhibit. Another long-held structure-property relationship is that centrosymmetric crystals cannot differentially absorb circularly polarized light.

In our recent paper, “Differential Absorption of Circularly Polarized Light by a Centrosymmetric Inorganic Crystal,” K. A. Parrish *et al*., Science, doi: 10.1126/science. Adr 5478 (2025); Erratum: doi: 10.1126/science. Aec 1372, we demonstrate the design, synthesis and characterization of the centrosymmetric material $Li_2Co_3(SeO_3)_4$, which violates this relationship, not by defying symmetry-imposed selection rules, but by invoking a photophysical process not previously characterized for crystalline solids. This process originates from an interference between linear dichroism and linear birefringence, referred to as LD-LB, enabling a chiroptical response under centrosymmetry, and involves strong chiroptical signals that invert upon sample flipping.

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