

A unique conducting state under UVirradiation

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A shot of UV light has produced a considerable flow of electric current like spring water in an insulating molecular crystal, which phenomenon originates from the unique original physical properties of this material, realized by the interplay between the two kinds of molecules shown in the image. [Copyright] Royal Society of Chemistry. Credit: Naito Toshio et al. from *Journal of Materials Chemistry C*



A highly conducting state has been found in a molecular crystal under UV-irradiation. The state reversibly appears in accordance with UVirradiation, but does not appear by any other method such as raising the temperature, which often induces metallic behavior in insulating molecular crystals. The UV-excited state exhibits conduction and magnetic behavior characteristic of metallic substances. The result suggests that there is an optically accessible, but thermally inaccessible, state of matter.

Photoconduction, where an insulating material exhibits a semiconducting property under photoirradiation, was found in 1873, and is now applied in various devices including optical sensors, CCD cameras, remote controllers and solar cells. This long-known important phenomenon has a weak point; it cannot produce high conduction metallic substances. Metallic conduction is more suitable or advantageous for application in <u>electronic devices</u>, because it consumes less energy than semiconductors. In our present work, we have found metal-like <u>conduction</u> behavior in a molecular crystal under UV-irradiation.

This material itself is unique in that, without irradiation, its behavior falls between metals and insulators. However, it turned out to be impossible to make it behave metallically in any method other than UVirradiation. Such a material is often "metallized" by applying high pressure or high temperature, but this was not the case for this particular material. In addition to the newly found metallic photoconduction, our finding is important because it indicates that there are other photoexcited states of matter possessing unique properties. In other words, we should explore the photoexcited states of various materials to find novel properties and functions just as chemists have done for hundreds of years by synthesizing new materials.



More information: Toshio Naito et al. A possibly highly conducting state in an optically excited molecular crystal, *Journal of Materials Chemistry C* (2019). DOI: 10.1039/c9tc00491b

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