

Optical properties of chiral PTCDI molecules investigated by STM-induced luminescence

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Chiral recognition has drawn an attractive attention from the viewpoints of biochemical analysis since most of organic molecules in living body has chirality [1,2]. For instance, proteins and sugars strictly recognize their chirality and product the harmless biological compounds. These chiral recognitions are very important effects on living organisms, and errors in chiral recognitions sometimes lead to serious drug-related problems. Therefore, it is essential to clarify the details of chiral interactions and their reaction mechanisms through investigating them at a nanoscale.

To identify the chirality of molecules, optical activity such as circular dichroism and optical rotatory dispersion have been estimated by conventional macroscale techniques. However, optical diffraction limit and low sensitivity unable us to estimate the optical activity from the nanoscale level. To overcome this disadvantage, we have investigated the optical activity of the molecule by using the scanning tunneling microscopy induced luminescence (STM-LE) [3] which combines high spatial resolved STM observation with the luminescence analysis. This method allows us to obtain the light emission at the nanoscale level.

In this study, by using the STM-LE, we have investigated the nanoscale optical activity of chiral binaphthyl Perylenetetracarboxylic dianhydride (BP-PTCDI) shown in Fig.1 which consists of organic semiconductor PTCDI and a chiral molecule, R-1,1' Binaphthyl.

First, BP-PTCDI molecules were deposited on the Al₂O₃/ NiAl (110) substrate which is often used for STM-LE measurement. We obtained the photon integration maps while scanning a topological STM image as shown in Fig.1. At the large positive sample bias-voltage, the luminescence from the single molecule indicated by green circles in Fig. 1 was observed. Then, we examined the difference of the intensities between the left- and right- circularly polarized luminescence on the single molecule.

We also obtained the luminescence from the molecular clusters in the same way. It was found that the luminescence intensity and the optical dissymmetry were different from the single molecule. The above results suggest that the luminescence intensity and optical dissymmetry depends on the cluster size and the configuration of the adsorbates on the substrate.

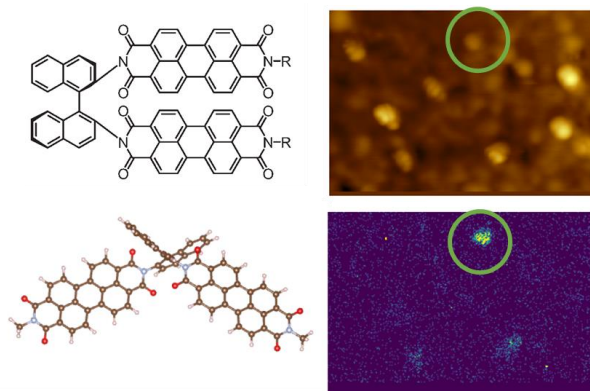


Fig. 1. Schematic model of chiral BP-PTCDI and STM topography images (right up) and corresponding photon integration maps (right down) of chiral BP-PTCDI (15x9 nm²).

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