

# ペンタセン単結晶における励起子エネルギー - 運動量分散関係の 低エネルギー角度分解電子エネルギー損失分光法による計測

## Exciton $E$ - $K$ Dispersion in Single Crystal Pentacene

### Measured by Low-energy Angle-resolved Electron Energy-loss Spectroscopy

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Management of exciton behaviors in organic semiconductor materials is of a keen demand for efficient development of organic opto-electronic devices. Excitons in molecular solids are generally regarded as a textbook example for Frenkel-type ones owing to localized characters of the electronic wave functions within individual molecules. However, inter-molecular delocalization of the electronic states has been confirmed for a number of crystalline molecular species [1], and the exciton characteristics in such “band transport” organic semiconductors potentially deviate from those of the conventional Frenkel exciton. In this study, the exciton energy - momentum ( $E$ - $K$ ) dispersion for the single crystal pentacene, in which the electronic band dispersion was experimentally observed [2], was observed by means of angle-resolved electron energy-loss spectroscopy (AR-EELS) [3] using a moderate primary electron energy ( $E_p \sim 10$  eV).

Figure 1 shows the AR-EELS spectra taken in the  $\Gamma$ -X direction of the single crystal pentacene. Peaks in an electron kinetic energy range of 8.2 - 8.4 eV, which corresponds approximately to the energy-loss of 1.9 - 2.0 eV, is attributable to the inter-band electronic excitation of the single crystal penacene. It was exhibited that the peak position of the energy-loss feature shifted by several 10 meV to the low kinetic

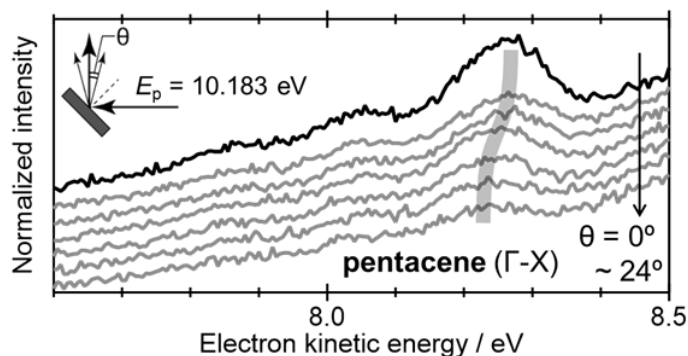


Fig. 1: AR-EELS spectra of a single crystal sample of pentacene taken along the  $\Gamma$ -X direction.

energy side as inclining the electron scattering angle  $\theta$  with respect to the specular direction, indicating the presence of the  $E$ - $K$  dispersion of the exciton. AR-EELS results for other crystallographic directions of pentacene will also be presented in this contribution.

[1] Y. Nakayama, et al., *J. Mater. Chem. C* **8** (2020) 9090.

[2] Y. Nakayama, et al., *J. Phys. Chem. Lett.* **8** (2017) 1259.

[3] H. Ibach, et al., *Rev. Sci. Instrum.* **88** (2017) 033903.