S_1 exciton formation yield in anthracene single crystal under excitation with 250 – 800 eV photons

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Introduction

Quantum yield Φ of S_1 exciton formation in anthracene single crystal was studied in an attempt to investigate the energy relaxation mechanisms of organic solid excited by high energy photons. Anthracene was chosen as a sample because of its high efficiency of S_1 fluorescence[1].

Eexperimental procedure and results

Anthracene single crystal was grown from powder with a sublimation technique. Typical size of sample was about 8 x 8 x 0.1 mm^3. Sample was glued on a copper substrate with a silver paste. After evacuation of an experimental chamber, sample was cooled down to 200 K with solid carbon dioxide in order to avoid the vacuum contamination due to vapor pressure of anthracene crystal. Radiation shield of the sample was kept at 77 K.

Experiment was performed at the beam line 7A of the Photon Factory with the same technique published already[1]. Irradiating an anthracene crystal with monochromatized synchrotron radiation beams, intensity I_{FSR} of S_1 fluorescence from the anthracene crystal was measured by a photomultiplier. Quantum yield Φ of the S_1 exciton formation was determined by a comparison of I_{FSR} with the intensity I_{F365} of S_1 fluorescence excited with 365 nm UV light beams from an mercury lamp, because the number of S_1 exciton is considered to be equal with the number of 365 nm photons. The number of 365 nm photons was estimated by a calibrated photodiode and the number of SR photons was estimated from the photoelectron yield of a Au plate. Obtained result was shown in the Fig.1. In Fig. 1, values of Φ measured at UVSOR, Okazaki, Japan are also shown for the energy region from 3 to 220 eV[2].

As seen from Fig.1, Φ shows the monotonous increase with the photon energy. It should be noted that a singularity is found at the carbon K edge energy (285 eV).

We examined the origin of the decrease in Φ at 285 eV. Since the bimolecular quenching of S_1 excitons is so well known[3], we examined the SR-intensity dependence of I_{FSR} with changing the slit width at SR photon energy of 275, 286.3, 293.6 and 340 eV, respectively (see Fig. 2). Straight lines in Fig.2 show the linear dependence of I_{FSR} on SR intensity, which means that bimolecular quenching of S_1 excitons is not

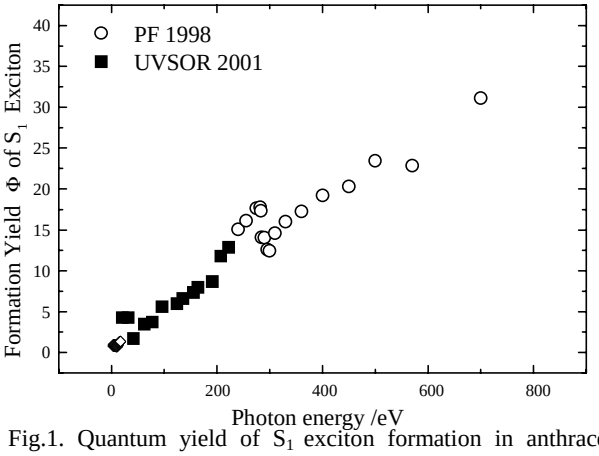

Fig.1. Quantum yield of S_1 exciton formation in anthracene single crystal as a function of excitation photon energy. ○: This work. ■ : Result at UVSOR.

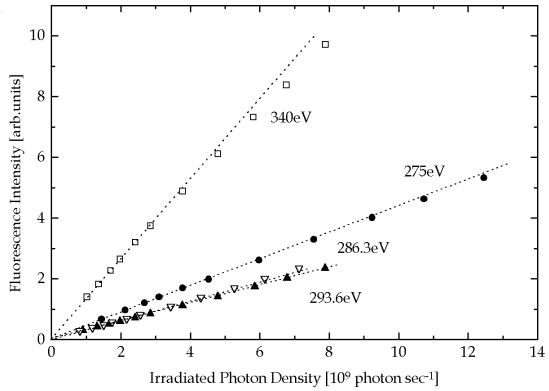

Fig. 2. Intensity of S_1 fluorescence excited with SR as a function of SR intensity.

responsible for this decrease inΦ at 285 eV. The origin of this decrease is not clear at the present time.

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References

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