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X-ray Induced Trap States in the Organic Semiconductor Rubrene TOBIAS MORF, TINO ZIMMERLING, SIMON HAAS, BERTRAM BATLOGG, ETH Zurich — The charge transport in organic semiconductors and thus the device performance is broadly affected by localised electronic states capturing charge carriers. In a controlled irradiation experiment, the formation and microscopic origin of these trap states is studied quantitatively. Rubrene crystals with a low pristine trap density are irradiated with monochromatised CuKα radiation. The spectral density of trap states (DOS) is determined by the well-established SCLC method before and after each exposure step. After irradiation, a well defined additional DOS peak is measured. Its density grows linearly by approximately 10^{17} trap states per Joule of absorbed energy. These new states are closely peaked around 0.3 eV above the HOMO (valence band) mobility level. The results are compared to those of the previous ion-irradiation study. Even though the ionic doses were higher by a factor of 10^3 we find very similar changes in the DOS both with respect to quantity and energy of the trap states. This remarkable result suggests a much higher trap creation efficiency of X-rays as compared to ion radiation. Furthermore, the two different radiation methods seem to cause the same type of microscopic perturbation of the molecular crystal.

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