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Time-resolved photoluminescence study of excitons in α-PTCDA as a function of temperature

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In the present work, we analyze the radiative and nonradiative recombination channels in α-PTCDA (3,4,9,10-perylene tetracarboxylic dianhydride) by applying time-resolved photoluminescence (PL) techniques in the 50 ns range between temperatures of T = 10 K and T = 300 K. The obtained PL spectra are decomposed into exponentially decaying components which can be assigned to different types of excitons, including Frenkel excitons, three types of self-trapped excitons, and two different high-energy PL satellites. From the temperature dependence of the PL spectra, we gain some insight into the influence of nonradiative processes on the decay time of the different PL bands. At room temperature, PL from Frenkel excitons and oppositely charged ionic pairs is quenched due to nonradiative recombination. In contrast to this behavior, the decay of a PL band assigned to excimers shows only a weak temperature dependence, so that it becomes the dominating radiative recombination mechanism at temperatures above T = 200 K.

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