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Intrinsic and Extrinsic Exciton Decay in HIPCO and COMOCAT Carbon Nanotubes JEREMY ALLAM, TARIQ SAJJAD, ZHONGYANG WANG, SOFIA SIDDIQUE, KONSTANTIN LITVINENKO, ANTONY MORETTI, University of Surrey, DIRK MERSCH, IZABELLA JUREWICZ, University of Surrey, ALAN DALTON, University of Surrey — The luminescence efficiency of semiconducting carbon nanotubes is limited by non-radiative decay of the exciton population. A wide range of quasiexponential and power law decays with different exponents has been reported, and attributed to exciton trapping at defects and exciton-exciton annihilation. The role of diffusion has been controversial and reported diffusion coefficients for carbon nanotubes differ by several orders of magnitude. Here we investigate diffusion-assisted trapping and annihilation processes in HiPco and CoMoCat carbon nanotubes with different defect concentrations. At low excitation, the HiPco nanotubes show quasi-exponential trapping, however at high excitation the population follows a diffusion-limited power law. We attribute this to filling of saturable traps under strong excitation, as demonstrated in Monte Carlo simulations, and at the highest excitation levels the intrinsic behaviour is revealed with distinct regions where decay is limited either by the reaction rate or by Fickian diffusion. In the CoMoCat nanotubes, the same regimes are observed but the diffusion-limited exponent is reduced from -0.5 to -0.3 indicating sub-diffusive transport. We show that this is consistent with a moderate population of shallow traps.

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