Engineering ultra-long charge carrier lifetimes in organic electronic devices at room temperature.

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We report on the observation of a one hour long charge carrier lifetime in a plastic electronic device at room temperature, this charge carrier lifetime figure is over four orders of magnitude longer than previously reported. We attribute this to electrons and holes being spatially separated shortly after exciton photogeneration by the potential gradients distribution set up within the device by doping. Numerical modeling suggests that the band structure of the device resembles a potential hill, which forces photogenerated electrons to drift towards the contacts, while trapping photogenerated holes in an electron poor region in the center of the device. Thus we demonstrate that by carefully engineering the potential profile in organic semiconductor devices the carrier lifetime can be tuned over nine orders of magnitude in time. Devices with ultra-long carrier lifetimes open up the possibility for new classes of plastic electronic devices such as ultra-low light level photodetectors. [1]

[1] Yajun Gao, Roderick C. I. MacKenzie, Yang Liu, Bin Xu, Paul H. M. van Loosdrecht, and Wenjing Tian, Adv. Mat. Interfaces **2**, 1400555 (2015).