Electron injection barrier and energy-level alignment at the Au/PDI8-CN₂ interface via current–voltage measurements and ballistic emission microscopy

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We probe electron transport across the Au/organic interface based on oriented thin films of the high-performance n-type perylene diimide semiconductor PDI8-CN₂. Temperature-dependent current–voltage characteristics and complementary ballistic electron emission microscopy studies reveal that rectification at the Au/PDI8-CN₂ interface is controlled by a spatially inhomogeneous injection barrier, that varies on a length scale of tens of nanometers according to a Gaussian distribution with mean value ~0.94 eV and standard deviation ~100 meV. The former gradually shifts to ~1.04 eV on increasing PDI8-CN₂ thickness from 5 nm to 50 nm. Experimental evidences and general arguments further allow to establish the energetics at the Au/PDI8-CN₂ interface. Our work indicates injection-limited current flow in PDI8-CN₂-based devices with evaporated Au electrodes.

(a) Schematic diagram of the Au/PDI8-CN₂/n-Si contact barrier diode and (b) the set-up for ballistic electron emission microscopy BEEM measurements. (c) Histogram of the local barrier heights extracted from individual BEEM spectra.