FET probes for organic/inorganic photoinduced charge transfer

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Charge transfer at organic-inorganic semiconductor interfaces is the fundamental electronic process of nanostructured organic electronics. Modified organic field effect transistors (OFETs) are ideally suited to probe the dynamics of photoinduced charge transfer at these interfaces. This technique offers a route to study buried interfaces relevant to applications in organic solar cells and light emitting diodes by isolating an interface that is often in series with many other layers. Devices are fabricated using a bottom-contact FET geometry with a thin layer of dispersed ZnO quantum dots at the interface between an SiO_2 gate dielectric and an overlying pentacene layer. Under illumination, reversible threshold voltage shifts of up to 50 V have been observed and persist for minutes to hours. Surface functionalization of the ZnO quantum dots with an organic self-assembled monolayer results in dramatic changes in the device characteristics. This approach provides information about the time scales involved in the forward and back-transfer processes for electrons in these hybrid organic-inorganic systems, and reveals the effects of molecular engineering at the interface.