

Abstract

One of the most important advantages of organic semiconductor is their solution-processability, which allows simple and low-cost manufacturing of organic electronic devices such as organic light emitting diodes (OLEDs) or organic memory (OMEM) devices that can be used for data storage. Our multilayered OMEMs rely on a solution processable, photochemically switchable organic semiconductor, whose intrinsic chemical and physical properties can be programmed by a light-induced switching process.

For such a switchable compound, it is important to show a high fatigue resistance over a large number of switching cycles. Switching of the compound by an external trigger affects its HOMO energy level, resulting in a reversible programmable charge carrier injection barrier between the subjacent layer and the so-called switching layer. Upon irradiation of the switching layer with UV-light, photocyclization of the molecular switch occurs via a singlet-state mechanism. According to the high energetic UV-light, also higher singlet-states are populated which leads to photodegradation of the switch. Recent findings emphasize that irradiation-induced degradation can be drastically reduced by introducing a triplet sensitizer to the photochromic compound, thereby facilitating photocyclization via a triplet state mechanism.

Recent investigations show that perfluorinated dithienylethenes (FDTEs), functionalized with a carbonyl-based organic triplet sensitizable moiety, can be reversibly switched into the so-called "open" and "closed" forms by UV and visible light, while simultaneously exhibiting a high fatigue resistance towards undesired irreversible side-reactions. Importantly, our triplet-sensitizable switches possess a high conversion to the closed state in photo-stationary state (PSS) in crosslinked thin films - a precondition for the application as a programmable hole transport layer (HTL) in our OMEM devices.

Our divergent synthesis pathway allows a reliable possibility to modify DTE-switches concerning the introduction of manifold substituents in α -position of respective thiophene moiety. Therefore, this concept emphasizes the synthesis of DTEs that can be individually tailored according to respective application purposes. It is part of current research to investigate the influence of the introduced triplet sensitizable units on the photophysical and electrochemical properties of respective crosslinked DTE in thin film and to further optimize these properties.