

# Abstract

The rapid increase in digitalization demands scientific and commercial attention to develop memory elements with a high data storage density. Solution-processable organic memories (OMEMs) are promising in this context because they are inexpensive and can be produced on flexible substrates. Here, one approach is to utilize organic photochromic switchable compounds, specifically dithienylethenes (DTEs). DTEs are thermally stable, fatigue resistant and undergo an electrically- or/and photoinduced ring-opening and -closing reaction. Due to the energetic difference between the frontier molecular orbitals of the closed and open isomer, DTE layers can be exploited as switchable charge transport layers; thus, controlling the electrical current in the device. This enables access to a multitude of intermediate states and offers potential for multi-level memory applications.

In this work, several methods are demonstrated to enhance the maximum ON/OFF ratio of OMEMs. Experimental approaches are presented in order to maximize the photostationary state of the DTE layer, and thus to increase the upper limit of the continuum of intermediate states. By gradual replacement of charge injection, charge transport, and electrode materials while preserving the fundamental structure of the reference device, the charge carrier transport in the various states of the devices is successively optimized. The applied approaches assume that the ON- and the OFF-state are dominated by different types of charge carriers. The optimized OMEM provides a maximum current ON/OFF ratio of ca. 200,000, which corresponds to a storage potential of up to 17 bits per pixel. Last, the optimized device is analyzed with regard to its practical application. For this purpose, the device performance is examined in the wake of multiple optical writing, reading, and erasing steps as well as in electrical switching experiments.