Surface Molecular Platforms for Memory Devices

M.Mas-Torrent,[a] C. Simao,[a] N. Crivillers,[a] J. M. Artés,[b] P. Gorostiza,[b] J. Veciana,[a] C. Rovira[a]

[a]Institut de Ciència de Materials de Barcelona (CSIC) and CIBER-BBN, Campus de la UAB, 08193 Bellaterra, Spain
[b]Institute for Bioengineering of Catalonia (IBEC), Baldiri Reixac 15-21 08028 Barcelona, Spain

mmas@icmab.es

Abstract

The increasing interest in miniaturizing electronic devices to achieve denser circuits and memories will eventually entail the utilization of molecules as active components. In particular, self-assembled monolayers of bi-stable molecules offer great perspectives for their use in binary logic gates since different input signals can lead to defined outputs.

For instance, the family of polychlorinated triphenylmethyl (PTM) radicals are persistent electroactive organic radicals that can be easily reduced to the corresponding anionic species which also show a high stability in solution. Both redox species exhibit different optical and magnetic properties and can be reversibly interconverted in solution.

Here, we describe the functionalization of surfaces (SiO_2, ITO and Au) with appropriately functionalized PTM radicals. The application of chemical or electrochemical inputs to such hybrid organic/inorganic surfaces result in different optical (absorption and fluorescence), wettability and magnetic outputs. Importantly, these systems exhibit an exceptionally high long-term stability and excellent reversibility and reproducibility (Figure 1).[1-2] Moreover, these surfaces can be patterned as well as electrochemically locally addressed.

Further, following the same methodology, the switch behaviour of surfaces functionalised with other electroactive molecules such as tetrathiafulavalenes has also been investigated.[3] These systems exhibit three-stable redox states and, thus, can allow for the execution of more complex logic operations and also increase further the data storage capacity by going from 2^n memory units in a binary system to 3^n in a ternary one.

All these robust molecular platforms permit hence to write, store and read information, which is very promising for developing non-volatile memory devices based on immobilized molecules, of great interest in Molecular Electronics. In the future we plan to combine several switchable molecular platforms in order to perform more logic operations.

References

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Figures

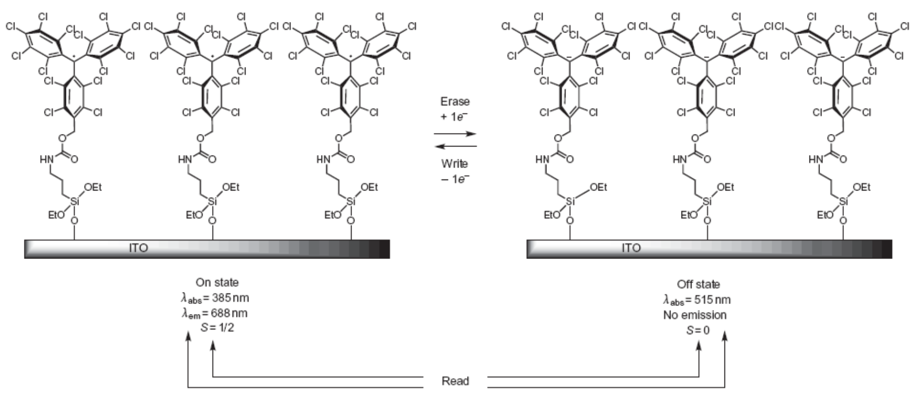

Figure 1. Schematic representation of the reversible switching between the two states of the hybrid organic/inorganic surfaces based on electroactive organic radicals