THE MECHANISM OF RESISTIVE SWITCHING OF LAYERS OF ROSE BENGAL

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Layers of Rose Bengal (4,5,6,7-Tetrachloro-2',4',5',7'-tetraiodofluorescein disodium salt) have been shown to switch between two stable conduction states by applying a positive or negative bias voltage above a certain threshold [1]. The high ratio of the resistances of the two conduction states (ON/OFF ratio) makes Rose Bengal a promising candidate for future molecular devices.

The switching mechanism is still in discussion. Possible explanations are a change in electrical conjugation of the Rose Bengal molecule due to electrochemical reduction and a twist of the upper benzene ring [2]. Similarly a formation of the oxidized form of Rose Bengal and a resulting higher mobility of the Na^+ ions could lead to a redistribution of the electric field and different conduction states.

To examine the conduction mechanism and the switching behaviour in more detail we have measured the I/V- characteristics of devices of Rose Bengal frequency and temperature dependent. The Rose Bengal layer was contacted by different top (Aluminum, Titanium) and bottom contacts (Indium Tin Oxide, Zinc Oxide).

Furthermore we have observed switching of layers of Rose Bengal contacted by an ITO layer as bottom electrode and a sharp diamond coated AFM tip as top electrode. Thereby we were able to rule out that metallic filaments are responsible for switching. In addition, this measurement proves that switching devices based on Rose Bengal are laterally scalable down to 10x10nm² (the contact area of the AFM tip), making high memory densities possible.

References:

[1] A. Bandyopadhyay, A. J. Pal, Apl. Phys. Lett. **82**,1215 (2003)
[2] A. Bandyopadhyay, A. J. Pal, Apl. Phys. Lett. 84, 999 (2004)