GLAD makes new organic memory devices possible

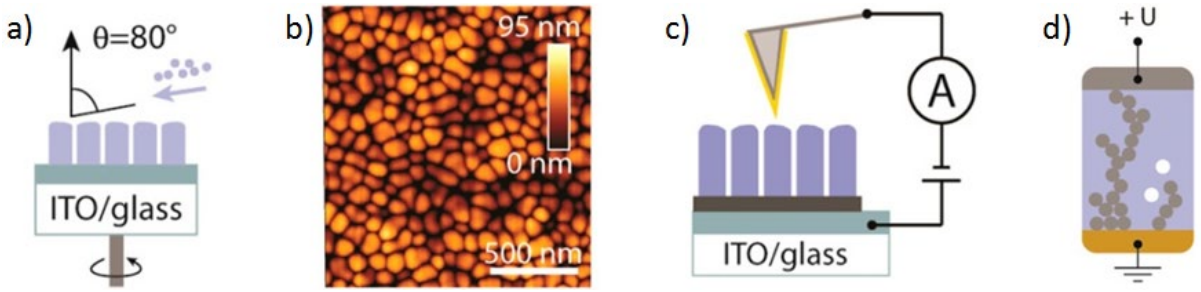
Giovanni Ligorio, Marco Vittorio Nardi, and Norbert Koch, member of IRIS Adlershof, have invented a new technique for constructing novel memory devices. The results have now been published in Nano Letters.

Author Dr. Giovanni Ligorio explains: "Novel non-volatile memory devices are currently investigated to overcome the limitation of traditional memory technologies. New materials such as organic semiconductors and new architectures are now considered to address high-density, high-speed, low-fabrication costs and low power-consumption.

Usually nano-devices (traditionally based on inorganic semiconductors) are fabricated via lithography techniques. Here, we show the fabrication of devices with nanometric footprint using a different technique: Glancing Angle Deposition (GLAD).

This technique allows the tailoring of nanostructured morphologies through physical vapor deposition (CVD) via controlling the substrate orientation with respect to the vapor source direction. When thin films are deposited onto stationary substrates under condition of oblique deposition, meaning that the vapor flux is non-perpendicular to the substrate surface, an inclined columnar nanostructured is produced.

Upon proper bias applied between the two electrodes of the memory device, it is possible to form a conductive path (or filament). The filament shorts the electrodes and drastically changes the resistivity characteristic of the device. Forcing a high current in the device, the filament can be distrust. This programs the device in the original high resistivity state. Since the process can be repeated consecutively we can program the device in a high or low resistive state (i.e. ON or OFF).



(a) Herstellung der Nanosäulen via CVD (b) AFM-Aufnahme der Säulen (c) Skizze der Ansteuerung (d) Skizze eine Säule mit Filament © G. Ligorio

We aim for the fabrication of devices in structured arrays (in this publication the nano devices are not ordered in array, but they are randomly distributed.)

This allows for connecting via cross bar electrodes, which can be fabricated via printing. This allows fabricating memory devices with a density of roughly 1 GB/cm² employing novel material for electronics, i.e. organic semiconductors."

Lithography-Free Miniaturization of Resistive Nonvolatile Memory Devices to the 100 nm Scale by Glancing Angle Deposition

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