

Dear members and friends of the CRC 1461,

In view of the upcoming Spring Retreat and the work that went into the first annual status report, we hope you excuse this short newsletter! However, we are happy to provide some science news again!

Science News

News from Maik (CAU, associated to C2):

Sparse CNT Networks with Implanted AgAu Nanoparticles: A Novel Memristor with Short-Term Memory Bordering Between Diffusive and Bipolar Switching

Recently, we accomplished to develop a memristive device based on silver-gold nanoparticles (AgAu NP) implanted into a network of carbon nanotubes (CNTs). Most other memristive devices are fabricated in a vertical geometry by thin film technology. This facilitates small distances, which are necessary for resistive switching phenomena. However, we established a fabrication route to achieve the nanoscale in a lateral orientation. A sparse network of CNTs is deposited onto a suitable substrate with sputtered gold electrodes. In this context, “sparse” means that the network shows no complete conductive path between the electrodes due to sufficient gaps in it. The width of these gaps is in the nanoscale regime, which enables the capability for resistive switching. Subsequently an underpercolated layer of AgAu nanoparticles is deposited onto the network with a Haberland-type gas aggregation source. The AgAu NP act as the source for filamentary ECM-type resistive switching (ECM = electrochemical metallization). Figure 1a shows SEM micrographs of those components illustrating the three length scales.

The switching mode resembles a hybrid of diffusive switching as reported previously by Vahl et al. and bipolar switching. This means that, after switching to the low resistive state (LRS) and then removing the voltage, the LRS is retained for a short amount of time in the second-range after which it changes back to the HRS by itself (see Figure 1b). But the LRS can also be reset to the HRS beforehand by applying reverse voltages. It is proposed, that this effect is due to the amount of available silver by surrounding nanoparticles. The amount of Ag is limited by the density of nanoparticles

but there is still enough to form filaments that retain for several seconds leading to a biologically plausible short-term memory effect. Further investigations might include a thorough study of the effects of nanoparticle density or an additional dielectric top-layer on the switching kinetics as well as simulations about the filament formation and collapse.

Info from the Office

The first annual status report for 2021 was timely submitted to the DFG.

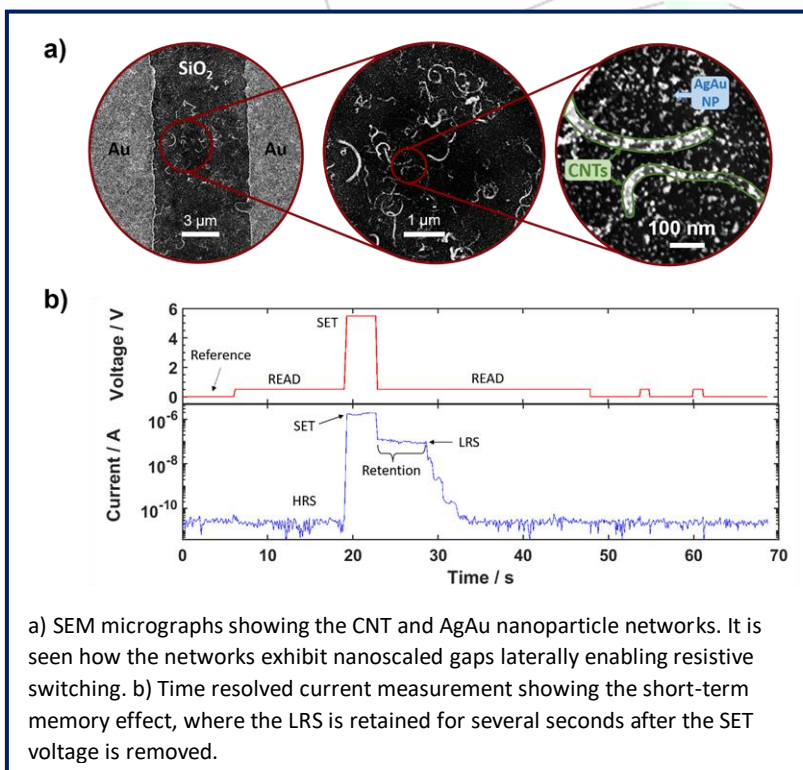
Upcoming Events

- Apr. 25, 2022, 14:00 – 15:30 iRTG General Assembly (online)
- Apr. 27 - 28, 2022 **CRC Spring Retreat** (Seeburg, Kiel)
- Jun. 29 – Jul. 01, 2022 Intelligent Materials Conference (IIM, CAU Kiel)
- Jul. 01, 2022, 08:00 – 10:00 Women’s Breakfast at the IIM
- Sep. 05 – 08, 2022 **CRC International Workshop** (CAU and Color Line)

See you at the Retreat!

Cheers,

Sonja, Leonie and Hermann



CRC 1461 - Publication Performance	
Journal papers (peer-reviewed)	18
Conference papers (peer-reviewed)	7
Conference contributions	26
Total	51