PHYSIKALISCHES KOLLOQUIUM

des Fachbereichs Physik
der Johann Wolfgang Goethe-Universität Frankfurt

Mittwoch, den 13.12.2016, 16 Uhr c.t.
Großer Hörsaal, Raum _0.111,
Max-von-Laue-Str. 1

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”Control of Switching Modes and Conductance Quantization in Oxygen Engineered HfO_x based Memristive Devices”

Hafnium oxide (HfO_x) based memristive devices have tremendous potential as non-volatile resistive random access memory (RRAM) and in neuromorphic electronics. Despite its seemingly simple two-terminal structure, myriad of RRAM devices reported in the rapidly growing literature exhibit rather complex resistive switching behaviors. Using a Pt/HfO_x/TiN based metal-insulator-metal structure as model system, we show that a well-controlled oxygen stoichiometry governs the filament formation and the occurrence of multiple switching modes. The oxygen vacancy concentration is the key factor in manipulating the balance between electric field and Joule heating during formation, rupture (reset), and reformation (set) of the conductive filament in the dielectric. In addition, the engineering of oxygen vacancies stabilizes atomic size filament constrictions exhibiting integer and half-integer conductance quantization at room temperature during set and reset. Identifying the materials conditions of different switching modes and conductance quantization contributes to a unified switching model correlating structural and functional properties of RRAM materials. The possibility to engineer the oxygen stoichiometry in HfO_x will allow creating quantum point contacts with multiple conductance quanta as a first step towards multi-level memristive quantum devices.

Die Dozenten der Physik

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