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Resistive switching in Mott insulators: From phenomenology to Mott memories

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The forecasted limitations of flash memories have triggered, in the last decade, the emergence of researches on alternative technologies for non-volatile data storage. Amongst the new class of involved materials, Mott memories have raised as promising candidates in the last editions of the International Technology Roadmap for Semiconductors (ITRS). Indeed, the application of electric pulses to narrow gap Mott insulators enables to switch back and forth between high and low resistance states, and thus to store binary data. The AM_4Q_8 (A=Ga,Ge; M=V, Nb, Ta, Mo; Q=S, Se) compounds form a family of prototypical Mott insulators which undergo this electric-field-driven insulator-to-metal-transition. The recent studies reveal that this resistive switching (RS) originates from an ionization impact process which triggers an electronic avalanche. This leads to the creation of conducting filaments where the Mott insulating state is broken at the nanoscale. Depending on the strength of the electric field, this phenomenon is either volatile or non-volatile. Our last experimental and theoretical works indicate that the non-volatile RS results from the stabilization of the volatile RS. Furthermore it has been shown that this property, which was first observed on single crystals, can be retrieved on thin films of GaV_4S_8. Finally the recent control of intermediate levels between high and low resistance states opens the way to the field of neuroinspired computing through the achievement of artificial synapses using this memristive behavior.

Biography

Julien Tranchant obtained his engineering diploma of Ecole Centrale de Nantes in 2002, and received his PhD in Materials Science in 2007 from Nantes University (France) working on stress engineering in thin films. After three years of R&D in the automotive lighting industry, he is now Associate Researcher at the Institute of Materials Jean Rouxel. His current research activities are devoted to resistive switching in Mott insulators, neuromorphic systems, non-volatile memories and thin film deposition by plasma techniques.

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