Electric-Pulse-Induced Metal-Insulator Transition in a Family of Mott Insulators : Towards Non-Volatile Mott-RAM Memories.

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The fundamental building blocks of modern silicon-based microelectronics, such as the transistor and its derivatives, are based on the control of electrical resistance by electrostatic charging. They could soon reach their miniaturization limits mostly because reliably keeping enough electrons in an always smaller cell size will become increasingly difficult. The control of electrical resistance at the nanometer scale therefore requires new concepts, such as using phase transitions rather than charge storage. The ultimate resistance-change device is believed to exploit a purely electronic phase change such as the Mott metal-insulator transition[1]. Theoretical studies indeed indicate/suggest that the Mott insulating state can be broken by the mere application of an electric field[2,3]. Recently, a non-volatile Electric-Pulse-Induced Resistive Switching (EPIRS), likely related to a Mott transition, was achieved in the Mott insulator $GaTa_4Se_8$[4,5,6]. In this presentation we will show that a volatile EPIRS is also observable in this compound. The non-volatile resistive switching appears then as a pinning of the electric-pulse-induced low resistance state. Furthermore, we also demonstrate the possibility to switch back and forth between high and low resistance states in a non-volatile way. As a consequence, this unique phenomenon, encountered in the whole class of isostructural spinel compounds AM_4X_8 (A = Ga, Ge ; M= V, Nb, Ta; X = S, Se), could be used in a new concept of non-volatile memory, the Mott - Resistive Random Access Memory (Mott-RRAM).

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