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Device physics and technology of correlated-electron random access memories

Carlos A Paz de Araujo
University of Colorado, USA

Semiconductors have been one of the major accomplishments of Condensed Matter Physics. Recently, quantum restrictions have slowed down their impressive growth, especially in the memory area. In this paper, a new switch-and-store device is presented from first principles to final samples introducing a novel memory based on Strong Electron Correlations generally based on the disproportionation $d^n + d^n = d^{n-1} + d^{n+1}$ common in certain Transition Metal Oxides. Similar efforts in the past 15 years, led to the so called "Filament Resistive Memories (ReRAMs)" which instead of exploiting the intrinsic localization (storing) and disproportionation (switching) and the well known Hubbard-Mott transition (HMT), created a paradigm of explaining away oxide breakdown and multi-layer charge trap as the consensus of ReRAMs physics. In our work, the underlying Physics of the HMT is used in a complete device model. The key technological breakthrough is a novel ligand substitution that reconstructs uncertain coordination-number and disproportionation, properly doped surfaces led to spontaneous metal-Insulator transitions with switching over 4K to 150 C and 400 C storage.

Biography

Carlos A Paz de Araujo is a full Professor of Electrical Engineering and a fellow of IEEE. In 2006, he received the Daniel Nobel award for his work in Ferroelectric Random Access Memories, which now has surpassed 1 Billion devices in the market. His areas of interests include nonvolatile memories and oxides in general. He has over 250 patents in the US and 300 overseas. His current work in CeRAM is focused at ultra nano-scale and embedded memories.

caraujo@aol.com

Formation of noble-gas dimers within fullerene's confinement

Eugene S Kryachko and Timofii Yu Nikolaienko
Bogolyubov Institute for Theoretical Physics, Ukraine

Van der Waals (vdW) He_2 diatomic trapped inside buckminsterfullerene's, C_{60}, void and preserved its diatomic bonding is itself a controversial phenomenon due to a smallness of a void diameter comparing to the He-He equilibrium distance. Using vdW-corrected density functional approaches (hybrid DFT M06-2X and ORCA package), we propound a computational approach, including smaller fullerenes, C_{20} and C_{28}, to demonstrate that encapsulation of He_2 inside the studied fullerenes exhibits an interesting quantum behavior resulting in a binding at shorter, non-vdW internuclear distances, and develop a computational model to interpret these He-He bonding patterns in terms of Bader's Atom-in-Molecule theory (AIM). We also conjecture a computational existence of $He_2@C_{60}$ on a solid basis of its theoretical UV absorption spectrum and a comparison with that of C_{60}.

Biography

Eugene S Kryachko has completed his PhD from Bogolyubov Institute for Theoretical Physics of the National Academy of Science of Ukraine. For about 20 years he worked abroad after receiving the Alexander v. Humboldt Fellowship in 1988 in LMU (Munich). He is the leading research scientist in the Department of Computational Methods in Theoretical Physics in Kiev. He has published more than 250 papers in reputed journals and serving as an Editorial Board Member of some of them.

eugene.kryachko@ulg.ac.be