Atomic Switch-type Resistive Memory

Keywords: Resistive switching memory, Quantized conductance, Solid electrolyte, Nanoionics

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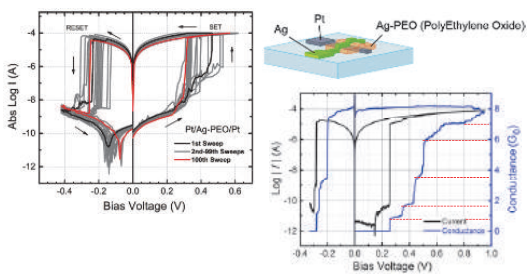
Background

- Downscaling of DRAM and flash memory approaches the physical limit.
- Novel volatile/non-volatile memories based on new operation principle are desired.
- Synthesis of new materials for such memories are also required.

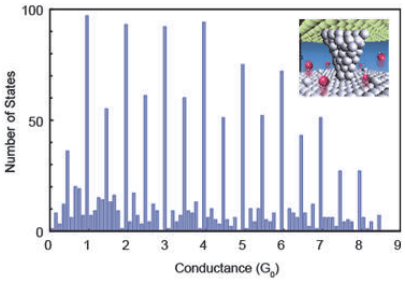
Aim

- Development of resistive memories called 'Atomic Switch', which are based on ionic transport and solid electrochemical reactions
- Realization of quantized conductance as well as bi-resistive switching
- Controlling of device performance using solid polymer electrolytes as the matrix

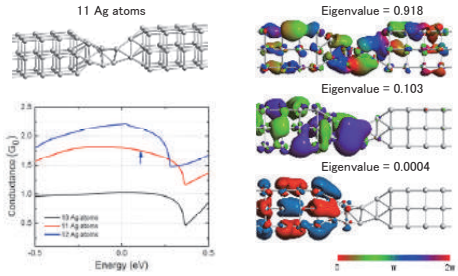
Advanced Research Topics



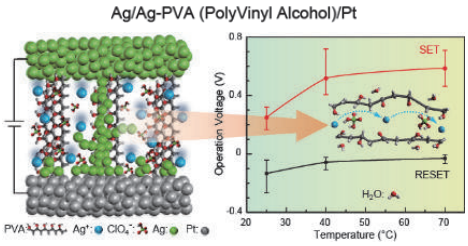
Bi-resistive switching (left) and quantized conductance (right) of Ag-PEO atomic switch



Quantized conductance distribution of Ag-PEO atomic switch



Transport simulation of atomic point contacts



Temperature behavior of Ag-PVA atomic switch

Publications

- K. Krishnana, M. Muruganathan, T. Tsuruoka, H. Mizuta, M. Aono, Adv. Fucnt. Mater. 27 (2017) 1605104.
- K. Krishnan, M. Muruganathan, T. Tsuruoka, H. Mizuta, M. Aono, Jpn. J. Appl. Phys. 56 (2017) 06GF02.
- K. Krishnan, M. Aono, T. Tsuruoka, J. Mater. Chem. C 6 (2018) 6460.

Summary

- Development of atomic switches using Ag-ion conductive polymer electrolytes
- Realization of quantized conductance supported by transport simulations for atomic point contacts
- Finding of polymer material for thermally stable switching

Research outcome

- Design of electrolyte material to achieve the desired device performance
- Development of atomic switches using other metal ions
- Film forming techniques to obtain uniform polymer electrolyte films