Ion dynamics in double barrier memristive devices

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1. The Double Barrier Memristive Device

2. Simulation Approach
   - Simulation of ions: Kinetic Monte Carlo
   - Simulation of electrons: Lumped element model

3. Simulation Results
   - I/U-Characteristic
   - Influence of charged point defects on resistance change
   - Voltage dependency of resistance change

4. Conclusion
Double Barrier Memristive Device\(^2\)

- Incorporated mechanisms are i) **motion** of charged defects, ii) **Adsorption** at Au surface and iii) **Desorption**.

- Ionic processes simulated using the **kinetic Monte Carlo** method.

kinetic Monte Carlo

\[ k_{ij} = \nu e^{-\frac{E_{ij}}{k_BT}} \]
Lumped Element Model

D: Schottky diode, representing the metal-semiconductor contact.

R: Resistance, representing memristive layer.

VDR: Varistor, representing the tunnel barrier.

\[^3\text{Solan E. et al., arXiv:1701.08068 (2017)}\]
I/U-Characteristic

(a) Experiment

(b) Simulation

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Defects and Resistance Change

Average Defect Distribution

$t = 10 \text{ s}$

$t = 30 \text{ s}$
- Metal-semiconductor contact provides an effective threshold for ionic motion.
Simulated findings could be validated by experimental findings.
1. The double barrier memristive device is a very promising device, especially for implementation in neural networks.

2. Kinetic simulations gave interesting insights into physical processes during resistive switching.
   - Ionic motion has been found to be the main reason of resistive switching.
   - A found threshold voltage for resistive switching could be linked to the metal-semiconductor contact.

3. Simulation and experimental results are in good agreement.

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