Researchers in ZeroAMP show how to build non-volatile memory from nano switches using the power of stiction

Within the ZeroAMP project, a team lead by the University of Bristol has worked out the principles of how to design non-volatile memory using nano relays.

The PI Dr. Dinesh Pamunuwa explained the significance of this work.

"A relay turns on when the tip of a flexible beam, suspended in air in the fashion of a cantilever or bridge, lands on a fixed electrode to establish a path for current to flow. In electrostatically operated relays, the beam moves due to electrostatic forces caused by a voltage applied between it and an adjacent, fixed gate electrode. When the voltage is removed, the elasticity in the beam pulls the tip back out of contact to the off state. A surface adhesion force exists between all types of contacting surfaces, typically including van der Waals, electrostatic and capillary force components, which is usually detrimental to the relay operating reliably; for example, if the adhesion force at the tip is larger than the restoring spring force, the relay does not switch off. In ZeroAMP, we use the surface adhesion force to our advantage to implement non-volatile memory, i.e. the relay stays switched when power is removed. The key challenge is, how do you reprogramme it?

In our latest work published in the *IEEE Journal of Microelectromechanical Systems*, we work out the principles of how to model and design bidirectional relays to implement reprogrammable memory devices. We have validated the concepts through experiments conducted on fabricated relays with a critical dimension of 80 nm. As these devices uniquely have the potential to work at 300 °C and absorb high levels of radiation with zero standby power across the entire operational range, non-volatile memories built from them are very useful in diverse applications such as the Internet-of-things (IoT), aerospace and industrial electronics."

This work has been published in the *IEEE/ASME Journal of Microelectromechanical Systems*: https://ieeexplore.ieee.org/document/9669034 (doi/ 10.1109/JMEMS.2021.3138022).

A pre proof version is available at https://research-information.bris.ac.uk/en/publications/theory-design-and-characterisation-of-nanoelectromechanical-relay.

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