# Ultralow-energy Computation with Perovskites

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Ion migration causes degradation of perovskite solar cells. Ions are moved easily, with only a few hundred meV activation energy. Still, ions move many orders or magnitude more slowly than charges in metal halide perovskites. We use this difference in timescales to imprint memory in a resistive device. These memristors can be used in neuromorphic devices to perform some computational tasks with very high energy efficiency. Because ions take very little energy to move, switching a memristive state in a perovskite device can also be very energy efficient. We show an artificial synapse that takes only a few hundred femtojoule to switch its resistive state[1]. This is achieved by downscaling the device to the micrometer scale. To avoid damage to the perovskite during lithography, we use a novel back-contact architecture for these devices. We further discuss the working mechanism of these devices. Likely the switching is achieved by filamentary formation. This mechanism would also allow to built artificial neurons. With a memristive device and an artificial neuron, full hardware neural networks could be built.

If time allows, I will also briefly discuss the implications of such filament formation on solar cell stability. We observe these filaments in lateral devices, and we see evidence for permanent, dramatic voltage-bias induced damage.

References:

[1] Preprint: http://dx.doi.org/10.2139/ssrn.4592586