Contribution ID: **177** Type: **Talk**

【814】Nanoscale magnetic ratchets based on shape anisotropy

Friday 25 August 2017 12:15 (15 minutes)

Controlling magnetization using piezoelectric strain offers unprecedented power efficiency for next-generation spintronic devices. However, strain is a uniaxial effect and, unlike directional magnetic field or spin-polarized current, cannot induce a full 180° reorientation of the magnetization vector when acting alone. We have engineered novel "peanut"and "cat-eye"shaped nanomagnets on piezoelectric substrates that undergo repeated deterministic 180° magnetization rotations in response to individual strain pulses by breaking the uniaxial symmetry using shape anisotropy. This behavior can be likened to a magnetic ratchet, advancing magnetization clockwise with each piezostrain trigger. The results were validated in micromagnetics simulations. This work provides a simple and effective design for developing future spintronic applications.

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Session Classification: Magnetism and Spintronics at the Nanoscale

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