

16-2018-4564 | Spin-Induced Local Magnetization for Memory and Logic Components Applications  
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Category	Nanotechnology
Keywords	Spintronics, Memory, Chiral, Electronics
Current development stage	General list: TRL4 Technology validated in lab

### Application

Miniaturization and densification of electronic components to the nanoscale has led to processors and memory that consume too much power and generate excessive waste heat. Technologies that can surpass the limitations of traditional semiconductor technologies enabling low-power consumption with no current transmission, while simultaneously hitting better performance targets, are vital to comply with Moore's Law.

Existing spin-based components suggest a way to solve these limitation, but currently are limited to ferromagnetic components, struggle to induce magnetic moments in sufficiently small domains, and are associated with complex multilayer fabrication processes and complicated magnetoresistance requirements.

### Our Innovation

Organic chiral molecules can function as the basis for new spintronic devices that consume negligible power, (> 1 MHz), and undergo facile fabrication.

- Magnetic domains on the order of 10 nm
- Does not contain any ferromagnetic components
- No current required
- Operates at room temperature

### Technology

The device is comprised of a GaAs/AlGaAs semiconductor-based heterostructure coated with chiral molecules on its surface and below the gate. A robust magnetic moment is switched on or off by applying a gate voltage. The spin injection is a manifestation of the recently observed chiral-induced spin-selectivity effect (CISS), which results in coupling between the electron spins and their linear momenta due to the spin-orbit coupling induced by the curvature of the electronic potential in chiral molecules. The device operates on the chemical potential mismatch between the two components, resulting in injection of electrons or holes, which are spin-polarized due to the CISS effect.

### Opportunity

The novel and efficient spintronic and memory device technology has various applications, replacing traditional semiconductor components in electronics:

- Memory (including MRAM and flash memory devices)
- Logic components
- Spin-based transistors
- Communication components
- High-power consuming components (e.g. transformers)
- Spintronic quantum computing

Patent Status

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