

Spin Current and Magnetoresistance from the Orbital Hall Effect

(No. T4-2053)

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Overview

An innovative method to generate spin current and magnetoresistance by leveraging the Orbital Hall Effect (OHE). This approach utilizes ordinary metals like Aluminum and Copper, combined with a thin layer of heavy metal to convert orbital currents into spin currents. By minimizing the reliance on expensive heavy metals such as Platinum and Tungsten, the technology significantly reduces production costs while preserving performance, making it highly suitable for spintronic and magnetic devices.

Applications

- Magnetic field sensors
- Spintronic and spin-torque devices
- Memory devices and computational applications
- Data storage solutions
- · Spin-based sensors for biomedical, environmental, and navigation uses

Differentiation

- Substantial reduction in heavy metal usage, lowering production costs
- Compatibility with existing CMOS fabrication technologies
- Independence from the Spin Hall Effect in Heavy Metals
- Use of key semiconductor metals (e.g., Copper, Aluminum) for spin current generation

Development Stage

The technology has been demonstrated at the die level, generating spin currents via the orbital Hall effect in Copper and Aluminum, with a thin Platinum layer enabling measurable results consistent with theoretical predictions.

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OHE measurement in Cu and AI: (a) Schematic of the trilayer system. (b) ΔHA vs. Jeffc for Cu and AI systems; solid lines fit measurements, dashed lines show OSTFMR fits. (c) ΔH vs. f res, with traces shifted to cross origin for clarity. (d) Summary of θ SH and α .

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References

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 [1]
- Rothschild, A. *et al.* Generation of spin currents by the orbital Hall effect in Cu and Al and their measurement by a Ferris-wheel ferromagnetic resonance technique at the wafer level. *Phys. Rev. B* 106, 144415 (2022). DOI: <u>10.1103/PhysRevB.106.144415</u> [2]

Patent Status



USA Published: Publication Number: US 2023-0309411 A1