

Microfabrication of FePt/W/FePt Multilayer Heterostructures via Photolithography for Spintronic Applications

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Abstract: This work reports on the design and microfabrication of magnetic multilayer heterostructures based on FePt thin films, targeting their integration in planar spin valve architectures. A key focus is placed on the development and optimization of a reliable fabrication strategy based entirely on multi-step photolithography, enabling precise pattern definition and alignment at the micrometer scale through the use of dedicated alignment markers.

The proposed technological route allows the sequential definition of the ferromagnetic electrodes and spacer layers while preserving structural integrity and interface quality, which are critical for spin-dependent transport. Compared to electron-beam lithography, photolithography offers clear advantages in terms of scalability, throughput, and compatibility with large-area processing. At the same time, in contrast to approaches based on continuous thin films, the present method enables controlled lateral patterning and device-level integration, which are essential for functional spintronic architectures.

The heterostructures incorporate tungsten (W) as a spacer layer, ensuring efficient magnetic decoupling between the FePt electrodes while maintaining favorable conditions for spin transport phenomena.

The fabricated structures were systematically investigated in terms of their morphological, compositional, and magnetic properties using complementary characterization techniques. The results confirm the successful realization of well-defined multilayer architectures with controlled geometry and material composition, demonstrating the suitability of the proposed fabrication approach for future spintronic device applications. These results highlight the potential of photolithography-based microfabrication as a scalable route toward practical spintronic devices, bridging the gap between fundamental thin film studies and functional device implementation.

Keywords: photolithography; microfabrication, magnetic multilayer heterostructures; FePt thin films.

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