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Thema: EuO_{1-x} – A highly versatile ferromagnetic semiconductor for the use in silicon-based spintronics

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EuO_{1-x} – A highly versatile ferromagnetic semiconductor for the use in silicon-based spintronics

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The ferromagnetic semiconductor europium oxide (T_C = 69 K) exhibits a multitude of giant properties such as metal-to-insulator transitions (MIT) that can cover up to 13 orders of magnitude change in resistance, colossal magneto-resistive (CMR) effects that rank amongst the biggest for bulk materials and the largest magneto-optic effects for any known material. Despite these outstanding properties, its instability in air has hampered its utilization for basic and device driven research since its discovery in the 1960's, when the core of today's knowledge about this material was established. Its predicted spin-polarization of 100% in the ferromagnetic state and its excellent electronic compatibility to the long spin decoherence length semiconductor silicon have spawned new interest in EuO in the rapidly growing field of spin-electronics.

Here we report about the epitaxial growth of EuO on various substrates including Si and GaN. To prevent the corrosion of the films in air, special capping and patterning techniques have been developed, allowing for the *ex situ* manipulation and measurements of the films as well as for the realization of complex device structures. Utilizing these techniques we demonstrate the best crystalline quality, the highest magnetization, and the most pronounced MITs and CMR effects reported for EuO films so far. By employing Andreev reflection spectroscopy we show spin-polarizations of lanthanum doped EuO exceeding 90% [1], strongly indicating that it is indeed a half metal. With the reported growth and processing techniques, we show a route for further investigations of this outstanding material as well as its utilization in spintronic devices.

[1] A. Schmehl *et al.*, Nat. Mater. **6**, 882 (2007)