

Seminar über die Physik der kondensierten Materie (SFB/TRR173 Spin+X und SFB/TR288 Kolloquium, TopDyn-Seminar)

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01-122 Newton Raum

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Physics of Metal/Si Interfaces for the Development of Spin MOSFETs

Spin Metal-Oxide-Semiconductor Field-Effect transistor (MOSFET) is a promising device [1] that utilizes the fundamental material in electronics: silicon (Si). In 2007, the electrical injection of spin current into Si was achieved, overcoming the challenge of "conductance mismatch" [2]. Over the past decade, extensive research has been devoted to studying the transport of spin current in Si, resulting in the realization of room temperature operation [3].

In our investigations to enhance the magnetoresistance ratio, we have focused on understanding the physics of the metal/Si interface and proposed three different approaches [4-6]. Firstly, we have made progress by improving the crystal alignment between the spin source material and the tunneling barrier through moderate-temperature thermal annealing [4]. Secondly, we have demonstrated the spin-dependent Seebeck effect, a novel spin caloritronic effect, for the first time using semiconducting materials [5]. Lastly, we have achieved a significant reduction in electrical resistance at the interface by implementing ohmic contact on non-degenerate n-type Si with ferrimagnetic material, resulting in a 100-fold improvement [6].

By leveraging these technologies, we anticipate a notable improvement in the magnetoresistance ratio, bringing us closer to practical device applications.

Reference

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