Current-induced Magnetization Control and Spin Transport in Ferromagnetic Heterostructures

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Spin-based electronics, or the so-called spintronics, is a research field whose aim is to use magnetic materials and the electron's spin to store, manipulate, and carry information in electronic devices. Spintronics offers very appealing and promising solutions to the rapidly growing computer and information technologies, which are in a constant need of denser data storage capabilities, faster and more efficient means to control and process data. In this seminar, we will review the most recent advances regarding electrical detection and manipulation of magnetic states in spintronic devices. We will focus on the spin-dependent electrical transport effects in ferromagnetic heterostructures with strong spin-orbit coupling, which give rise to an array of highly intriguing phenomena, such as spin-orbit torques [1], unusual magneto-resistive behaviors [2], and current-induced switching/domain wall motion [3]. We will conclude by commenting on the future challenges and potential directions in all-electrical control of magnetization.

[1] Garello et al., Nat. Nanotech. 8, 587 (2013).
[2] Avci et al., Nat. Phys. 11, 570 (2015).
[3] Miron et al., Nature 476, 189 (2011); Liu et al., Science 336, 555 (2012); Avci et al., Nat. Mater. 16, 309 (2017).

Biography:
Dr. Avci obtained his Ph.D. degree in Materials Science from ETH Zurich in 2015 with a project on "Current-induced effects in ferromagnetic heterostructures with strong spinorbit coupling". He then moved to Massachusetts Institute of Technology as a post-doc between 2016 and 2018 and worked in oxide-based spintronics. He is currently working at ETH Zurich as a senior post-doc, and his research focuses on the spin-charge interconversion phenomena, current-driven domain wall motion, and magnetoresistive effects in multilayered ultrathin films.