



Contribution ID: 48

Type: Poster

Controlling Magnetic Behavior of Nanowires Through Artificial Defects: A Micromagnetic Study.

Saturday 1 November 2025 11:45 (1 hour)

Imperfections in magnetic nanowires can lead to significant changes in their magnetic behavior. Therefore, it is essential to study the effects such defects can have on their magnetic properties. In this work, we perform micromagnetic simulations of magnetic nanowires with artificial defects, and investigate how surface and internal defects influence their hysteresis loops and coercive fields. Our results demonstrate that the size, shape, and position of defects strongly affect the magnetic behavior of nanowires. In particular, artificial defects of identical size and shape but placed at different positions along the nanowire axis leads to notable differences in hysteresis loops and coercivity. The simulations also reveal how the defect's position governs the magnetization reversal process, offering insight into the underlying physics. The mechanisms of magnetization reversal, and their connection to variations in coercive fields, have been investigated by means of snapshots of the magnetization before and after reversal. These findings show that the magnetic response of nanowires can be deliberately tuned by introducing artificial defects, paving the way for device designs where performance can be controlled via engineered imperfections. All simulations were performed using the MuMax3 micromagnetic simulation package.

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Session Classification: Poster Presentations

Track Classification: Track 03: Material Science & Nano-science, Quantum Thermodynamics & Statistical Physics