Resistivity Characterization of Bottom-up Grown Antiferromagnetic Nanowires

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This bachelor project introduces the student to relatively complex material characterization and device fabrication techniques through transport measurements on quasi-one-dimensional antiferromagnetic nanowires with the Cu_2Sb-type structure (e.g., tetragonal CuMnAs). Antiferromagnets offer zero stray fields, robustness to external magnetic noise, and ultrafast spin dynamics, making them attractive for dense, low-power devices. Confining such materials to nanowires further enhances interfacial control, modulates magnetic anisotropy, and accesses 1D transport regimes relevant for spin-torque devices and AFM memory concepts. The project goal is to establish reliable baseline resistivity metrics and simple anisotropic magnetoresistance (AMR) signatures as a foundation for future resistance manipulation experiments.

Working with bottom-up grown nanowires, the student will (i) identify suitable wires via SEM, (ii) define four-terminal contacts (EBL + Ti/Au or FIB-deposited Pt), and (iii) perform wire-bonding for low-noise measurement. Using a variable-temperature setup (5–300 K) and modest magnetic fields, they will record I–V characteristics to verify ohmic behavior, measure R(T) to extract the residual resistivity ratio (RRR) and dominant scattering trends (e.g., metallic vs. activated regimes), and attempt to acquire magnetoresistance with field angle sweeps to probe AMR as an indirect handle on crystalline/magnetic/geometrical anisotropy. A stretch goal, if time permits, is to test the nanowires for presence of quench resistance switching by observing time-dependent resistance changes after introducing high voltage pulses. The project will be carried using the cleanroom facilities at the Institute of Physics at Cukrovarnická.

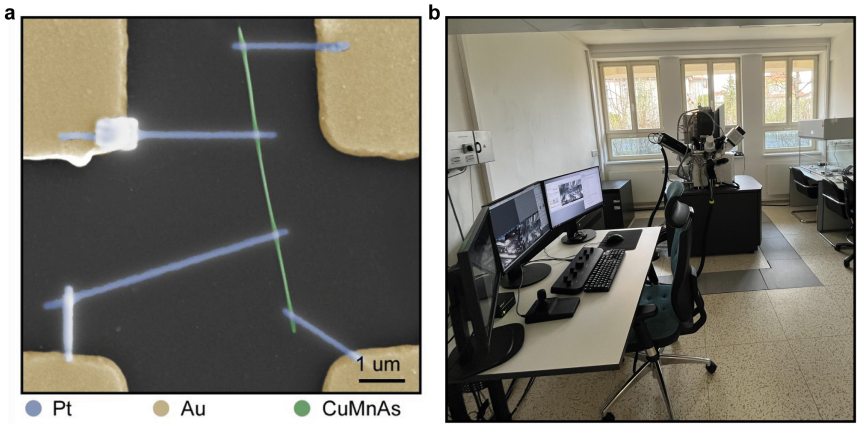

Figure 1: **a** False colored scanning electron microscope image of a CuMnAs nanowire 4-probe device fabricated for resistivity characterization. **b** Our FIB/SEM microscope.

References

[1] Strnad, J. Diploma Thesis: https://dspace.cuni.cz/handle/20.500.11956/202262, (2025).

[2] Givargizov, E. I. Journal of Crystal Growth 31, 20-30 (1975).