# Towards superconducting spintronics with RuO2 and CrO2 nanowires

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# Propositions

accompanying the thesis

## Towards Superconducting Spintronics with $RuO_2$ and $CrO_2$ Nanowires

1. The morphology and transport properties of selective area grown $CrO_2$ 'easy' wires (wires directed along the magnetic easy axis) are very different from 'hard' wires, unlike the easy and hard axis wires obtained from Ar-etched $CrO_2$ films. (*Chapter 3 of this thesis*)

2. The critical current density for the depinning of a magnetic domain wall in $CrO_2$ wires is of the same order as in conventional ferromagnets like Permalloy. The nearly 100% spin polarization in $CrO_2$ does not lead to reduction in depinning critical current density. (*Chapter 4 of this thesis*)

3. The temperature dependence of the critical current in weak links of antiferromagnetic $RuO_2$ is different from that in normal metal weak links, where it is governed by diffusive dephasing of Cooper pairs under the influence of temperature. Instead, a temperature-independent mechanism appears to take over at low temperatures around 2K. (*Chapter 5 of this thesis*)

4. Depositing a thin layer of protective material like $RuO_2$ *in situ* with $CrO_2$ is probably a more controlled process than Ar-etching the insulating oxide layer in a low pressure oxygen deficient system. (*Chapter 6 of this thesis*)

5. Pendio-epitaxial non uniform growth of $CrO_2$ wires inside the trenches probably is indicative of residues of $SiO_2$ at the surface of the trench. (*A. Singh et al., Phys. Rev. X 6, 041012 (2016)*)

6. The spin polarization nature of supercurrents in ferromagnets remains to be observed or demonstrated, for instance by observing the interaction of the supercurrent with a magnetization or a domain wall. (*J. Linder et al., Nat. Phys. 11, 307–315 (2015)*)

7. Even though the ferromagnetic Heusler alloy $Co_2FeAl_{0.5}Si_{0.5}$ only has 80% spin polarization, this is still significantly larger than the spin polarization found in $^3$d ferromagnets. The material might be a good candidate to study long range proximity effects, because it should be easier to fabricate transparent interfaces. (*M. Vahidi et al., APL Materials 2, 046108 (2014)*).

8. It has been shown that supercurrents can also be induced in van der Waals-type ferromagnets. These materials bring new possibilities, because the magnetism can be influenced by electrical gates. (*G. Hu et al., Nature Comm. 14, 1779 (2023)*)

9. An unsuccessful research is much riskier for a PhD candidate than for researchers with a permanent position.

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