Iron-rich phyllosilicates as 2D magnetic insulators

Aleksandar Matkovic[1],
Muhammad Zubair Khan[1], Oleg E. Peil[2], Apoorva Sharma[3], Daniel Knez[4], Lorenz Romaner[2], Dietrich R. T. Zahn[3], Ferdinand Hofer[4], Georgeta Salvan[3], Johann G. Raith[5], and Christian Teichert[1]
[1] *Institute of Physics, Montanuniversität Leoben, 8700 Leoben, Austria.*
[2] *Materials Center Leoben Forschung GmbH (MCL), 8700 Leoben, Austria.*
[3] *Semiconductor Physics, Chemnitz University of Technology, D-09107 Chemnitz, Germany.*
[4] *Institute of Electron Microscopy and Nanoanalysis (FELMI), 8010 Graz, Austria.*
[5] *Chair of Resource Mineralogy, Montanuniversität Leoben, 8700 Leoben, Austria.*
aleksandar.matkovic@unileoben.ac.at

Driven mainly by the potential applications in spintronics, magnetic random-access memories and sensing, magnetic van der Waals materials have attracted wide attention in the last years. While the field focuses mainly on layered iodides/tellurides and diluted layered magnetic semiconductors, the class of magnetic phyllosilicates remain almost completely unexplored. The mineral class of phyllosilicates (layered silicates) counts more than 240 members, and many of these minerals are known to incorporate local magnetic moment baring ions as Fe/Ni/Co which substitute Mg/Al sites in the central octahedral group. These naturally occurring magnetic van der Waals materials could serve as a novel and versatile platform for 2D magnetic insulators.
This talk will present our recent findings on layered magnetic minerals, mainly focusing on iron-rich talc (Fe:talc) [1] and briefly overviewing also iron-vermiculites, iron-micas, and iron end-members annite, and minnesotaite. These systems can serve as scaffolds to incorporate local magnetic moment baring ions in high concentration. Capping silicate/aluminate tetrahedral groups in their monolayers enable ambient stability, while magnetic properties could be tailored in the central octahedral site of the monolayers.

References

[1] A. Matković, *et.al.,* npj 2D Materials and Applications **5**, 2021, 94.

Figures

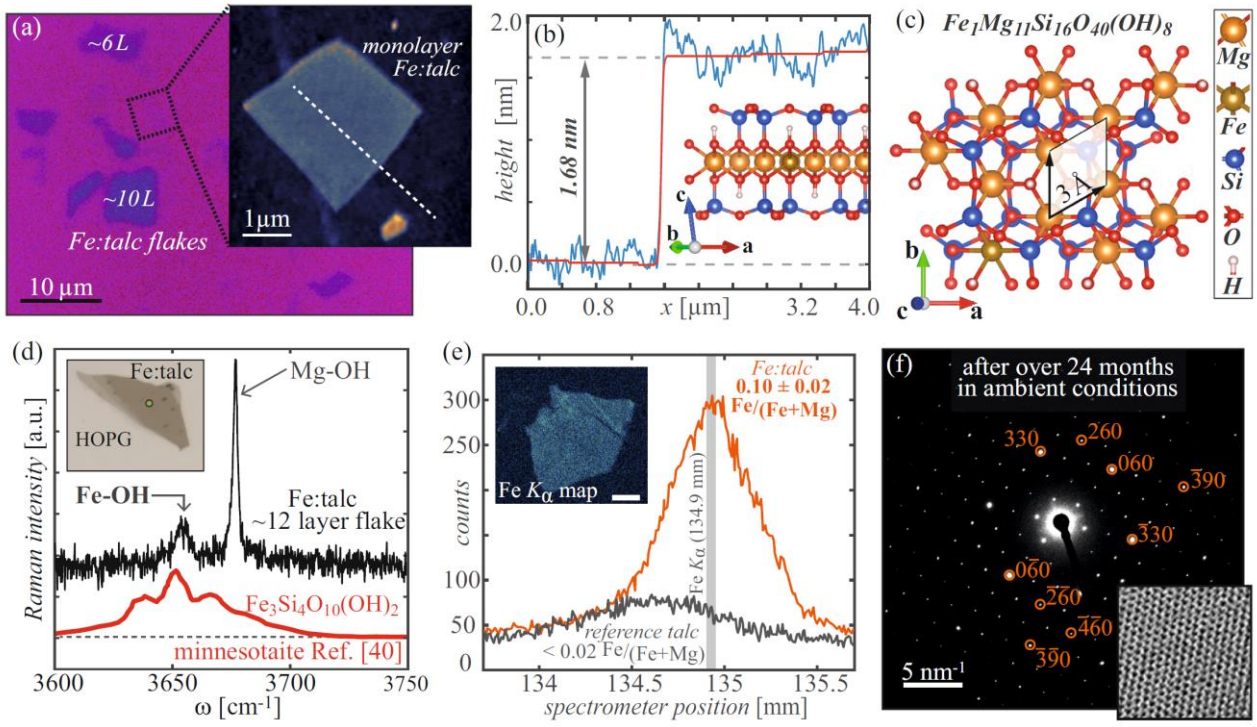

Figure 1: Iron-rich talc. (a) Fe:talc flakes exfoliated on SiO_2/Si (inset AFM topography of a monolayer). (b) step-edge cross-section with the side-view of the structural model. (c) top view of the Fe:talc-structure. (d) Raman spectra of the Mg/Fe-OH modes. (e) WDS quantitative analysis of Fe-concentration. (f) SEAD of a suspended flake after over two years of ambient storing.