Naturally occurring magnetic 2D materials

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Magnetic ordering in monolayers of van der Waals materials have attracted wide attention in the last years. To reach the full potential that intrinsic 2D magnetic materials have to offer they must be air stable even in monolayers, and the critical ordering temperature must be above room temperature. Recent breakthroughs in diluted magnetic semiconductors give one of the most promising groups of 2D magnetic materials, however, their magnetic properties and stability largely depend on fine control over the dopant concentrations and distribution. Naturally occurring magnetic van der Waals materials could potentially serve as a platform for 2D magnetism resolving the issues that hinder further integration of both diluted magnetic semiconductors and layered iodides/tellurides.

This talk will present our recent findings on layered magnetic minerals, mainly focusing on iron-rich phyllosilicates of talc and mica groups, as iron-talc, iron-vermiculites, 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.

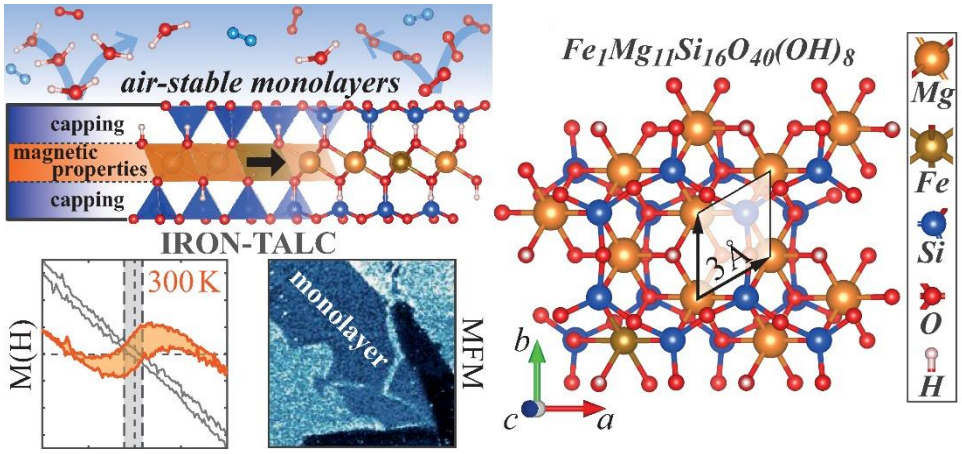

Fig. 1. Iron-rich talc as an example of naturally occurring magnetic layered materials: (top-left) side-view of the structure, also illustrating the concept of ambient stability. (right) top-view of the structure. (bottom-left) magnetization loop of iron-rich (orange) and iron-poor (grey) talc samples and magnetic force microscopy image of a monolayer iron-talc flake.