DS 5: 2D Materials and their Heterostructures III

Time: Tuesday 9:30–10:45 Location: SCH A 316

Invited Talk DS 5.1 Tue 9:30 SCH A 316

***Operando* infrared studies of confined water and protons in MXene** — •Mailis Lounasvuori — Helmholtz-Zentrum Berlin, Berlin, Germany

MXenes are a large family of 2-dimensional transition metal carbides, nitrides and carbonitrides with excellent potential for energy storage applications. Due to hydrophilic surfaces and weak attractive forces between the negatively charged layers, MXenes can retain significant amounts of water between the layers, and they can be intercalated with a variety of cations and molecules. Here, I will present our recent research efforts to apply *operando* infrared spectroscopy to probe the vibrational dynamics of water confined between Ti_3C_2 MXene sheets during electrochemical charging and discharging. Data for both lithium- and proton-containing electrolytes will be presented. Potential-dependent, reversible changes in the O-H stretching modes of confined water are observed that are specific to the cation. In acidic electrolyte, we observe a unique signature of confined hydrated protons which is not seen in the bulk.

DS 5.2 Tue 10:00 SCH A 316

Contact Printed Micro Circuit Boards - A Novel Platform for the Defect Free Integration of 2D Materials — •Christian N. Saggau[1], Sanaz Shokri[1,2], Yejin Lee[1,2], Mickey Martini[1,2], Tommaso Confalone[1], Genda Gu[3], Valentina Brosco[4], Domenico Montemurro[5], Valerii M. Vinokur[6], Kornelius Nielsch[1,2,7], and Nicola Poccia[1] — [1]Leibnitz Institute for Solid State and Materials Science Dresden, Dresden, Germany — [2]Institute of Applied Physics, Technische Universität Dresden, Dresden, Germany — [3]Condensed Matter Physics and Materials Science Department, Brookhaven National Laboratory, Upton, USA — [4]Italian National Research Council, Institute for Complex Systems, Rome, Italy — [5]Department of Physics, University of Naples Federico II, Naples, Italy — [6]Terra Quantum AG, St. Gallen, Switzerland — [7]Institute of Materials Science, Technische Universität Dresden, Dresden, Germany

The 2D cuprate superconductor BSCCO, promises upon integration with CMOS electronics, on-chip high temperature superconducting single photon detectors or quantum interference device (SQUID). Unfortunately, its properties degrade quickly if exposed to elevated temperatures, solvents, oxygen or water. Here we present Hall devices with a record thin film Tc of 91 K, which is identical to the bulk value of the crystal. Electrical contacts were established through transfer-printable circuits embedded in SiNx nanomembranes. The membrane incapsulates the material shielding it from the environment, while via contacts are used to form the electrical contacts.

DS 5.3 Tue 10:15 SCH A 316

Probing magnetic ordering in air stable iron-rich van der Waals minerals — •Muhammad Zubair Khan[1], Apoorva Sharma[2], Sergio Valencia[3], Florian Kronast[3], Oleg E. Peil[4], Georgeta Salvan[2], Christian Teichert[1], and Aleksandar Matković[1] — [1]Institute of Physics, Montanuniversität Leoben, Austria. — [2]Institute of Semiconductor Physics, Technische Universität Chemnitz, Germany. — [3]Department of Spin and Topology in Quantum Materials, Helmholtz-Zentrum Berlin, Germany. — [4]Materials Center Leoben, Austria.

We demonstrate magnetic ordering in Fe-rich two-dimensional (2D) phyllosilicates: annite, minnesotaite, and biotite. These van der Waals (vdW) minerals, incorporate local moment baring iron (Fe) ions via magnesium (Mg) substitution. The phyllosilicate capping silicate/aluminate tetrahedral groups make monolayers air stable. Superconducting quantum interference device vibrating sample magnetometry (SQUID-VSM) was used probe long-range magnetic ordering in bulk. In-field magnetic force microscopy (MFM) confirmed the local magnetic moment at room temperature, present down to monolayers. X-ray photoelectron spectroscopy (XPS) were used to observe the Fe oxidation state and to establish a correlation with magnetic ordering. Further, magnetic ordering in thin flakes was probed via X-ray magnetic circular dichroism. Our study of Fe-baring vdW minerals may drive the development for controllable synthesis of novel 2D magnetic insulators.

DS 5.4 Tue 10:30 SCH A 316

Anisotropic Spontaneous Magnetostriction in $Fe_{3-x}GeTe_2$ — •Reinhard K. Kremer and Eva Brücher — MPI for Solid State Research, Stuttgart, Germany

By determining the lattice parameters as a function of temperature of the hexagonal van der Waals ferromagnet $Fe_{2.93(2)}Ge_{1.02(3)}Te_2$ we detect a spontaneous negative in-plane magnetostriction occuring below the Curie temperature. The spontaneous magnetostriction follows the square of the spontaneous magnetization and leads to an expansion of the hexagonal layers, and is clearly seen for the in-plane lattice parameter a, but less well pronounced perpendicular to the planes along c. Extrapolating to $T \to 0$ K we obtain a saturation spontaneous magnetostriction of $\lambda_{sp,a}(T \to 0)$ = -214(6) $\times 10^{-6}$ and a volume magnetotriction $\lambda_{sp,vol}(T \to 0) \approx -450 \times 10^{-6}$, indicating that the spontaneous magnetostriction along c is very small. The linear thermal expansion coefficients at 295 K of $Fe_{2.93(2)}Ge_{1.02(3)}Te_2$ amount to 13.9(1)$\times 10^{-6}$ K^{-1} and to 23.22(15)$\times 10^{-6}$ K^{-1} for the in-plane and out of plane direction, respectively, indicating in a linear volume thermal expansion coefficient of 51.0(2)$\times 10^{-6}$.