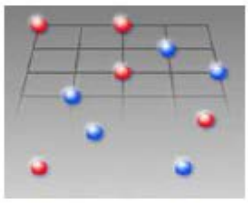

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JOHANNES GUTENBERG UNIVERSITÄT MAINZ

Fachbereich Physik, Mathematik und Informatik

SFB TR49/ SFB TRR 173 Spin+X - Kolloquium -
Seminar experimentelle Physik der kondensierten Materie

Donnerstag, den 12.03.2020 um 14:15
im MAINZ Seminarraum, Staudinger Weg 9, 03-122

Dr. Aga Shahee

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Doping tunable multiferroicity in $PbCu_3TeO_7$ and magneto-electric coupling in Van der Waal $CuCrP_2S_6$

$PbCu_3TeO_7$ with Cu^{2+} in a spin half state is an insulating, anisotropic frustrated magnet system. The Cu^{2+} ions are arranged in a buckled kagome-staircase geometry like that of $Ni_3V_2O_8$ with significant intra- and inter-kagome plane couplings [1]. The Cu^{2+} with quantum spin state of S= ½ spins occupies two inequivalent crystallographic sites, so-called cross-tie tetrahedral and spine octahedral ones. It exhibits two magnetically ordered states with antiferromagnetic transitions at T_{N1} = 35 *K* and T_{N2} = 24 K. Below T_{N2}, it displays magnetic field induced inversion symmetry-breaking, spin-flop transition coupled with ferroelectricity (multiferroicity) above the spin-flop transition field (Hs) ~ 8.3 *T* [2]. Thus, $PbCu_3TeO_7$ provides a good platform to tune magnetoelectric coupling and magnetic phases by chemical substitution or pressure. In order to tune competing magnetic phases and stabilize the multiferroic phase at zero fields, we have doped non-magnetic Zn^{2+} ion at Cu^{2+} site to form $Pb(Cu_{1-x}Zn_x)_3TeO_7$ ($0.0 \leq x \leq 0.2$) polycrystals. T_{N1} and T_{N2} are suppressed rapidly with increase of Zn doping ratio [3]. Simultaneously, the H_s also reduces from ~8.3 *T* for x = 0 to ~1 *T* for x = 0.2, and finally ferroelectricity is induced at zero magnetic field with a much reduced electric polarization as compared with the one observed at 9 T [3]. Monte Carlo simulation indicates that the substantial reduction in magnetic transition temperatures with the increase of substitution is due to the non-magnetic nature of Zn^{2+} and its cross-tie site preference [3]. Based on magnetization, dielectric constant, electric polarization and MC simulations results, we have developed magneto-electric phase diagram of $Pb(Cu_{1-x}Zn_x)_3TeO_7$ as a function of site-preferential Zn substitution and temperature. The possible origin of tuning of multiferroicity in $PbCu_3TeO_7$ viz the site preferential Zn^{2+} doping will be discussed.
The magnetoelectric manipulation in magnetic Van der Waals materials is becoming one of the most favored strategies for exploring emergent functionalities and searching for potential new devices for next generation of electronic and energy applications. In this talk, we will present experimental evidences of magneto-electric coupling in the single crystal of 2D Van der Waal multiferroic $CuCrP_2S_6$. In particular, the magnetic field induced electric polarization below antiferromagnetic state (T_N = 32 K) and its origin based on the p-d hybridization mechanism will be discussed.

References

[1] B. Koteswararao, R Kumar, J. Chakraborty, B-G. Jeon, A. V. Mahajan, I. Dasgupta, K. H. Kim and F C Chou, J. Phys.: Condens. Matter **25** 336003 (2013)
[2] K. Yoo, B. Koteswararao, J. Kang, A. Shahee, W. Nam, F. Balakirev, V. S. Zapf, N. Harrison, A. Guda, N. Ter-Oganessian and K. H. Kim, npj Quantum Materials 3, **45** (2018).
[3] A. Shahee, C. B. Park1, N. Ter-Oganessian, and K. H. Kim, to be submitted.

The guest is invited by Prof. Dr. M. Kläui
Everybody interested is welcome!