DYNASTY

DYNAmics and STructural analYsis of 2D materials

IESL SEMINAR

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FORTH Seminar Room 1

Understanding structure/property relationships in Quantum materials

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Abstract:

Quantum materials have been at the heart of lots of research over the past decades, interfaces in those complex materials can give access to properties not present in the bulk (superconductivity, 2DEG, magnetic order…. I will start introducing interfaces and discussing the ways available to look at them and the crucial role of TEM and STEM. In a second part I will review works I performed in the last few years about magnetic anisotropy in manganites and how to tune it [1-4]. I will finish this part on manganites by showing how strain engineering can stabilize ferroelectricity in 2 unit cell BTO [5]. I will then turn to nickelates showing how tuning the octahedral tilt of a RNiO3 (R=La, Sm, Nd) layer with another perovskite spacer layer (SrTiO3, LaFeO3, …) can tune its metal insulator transition (MIT) temperature at ease.[6-8]

The properties in bulk materials can further been modified by applying different stimuli (temperature, strain, atmosphere change, electric field) which can nowadays be provided in-situ in dedicated sample holders in the TEM making "operando"-measurements possible. I will illustrate this with two recent examples studying the MIT of VO2 as a function of pressure [9] and temperature [10] as well as the appearance of a new state after quenching the electric from the metallic state in Ca2RuO4 [11]

[1] Z.L. Liao, et al., Nature Materials 15 (4), 425-431 (2016)
[2] Z.L. Liao, et al., Advanced Functional Materials 26 (36), 6627-6634 (2016)
[3] Z.L. Liao, et al., Advanced Functional Materials 27(17), 1606717 (2017)
[4] N. Gauquelin, et al., 181, 178-190 (2017)
[5] B. Chen, et al., Nature Communications 13 (1), 265 (2022)
[6], Z.L. Liao, et al., PNAS 115 (38), 9515-9520 (2018)
[7] B. Chen, N. Gauquelin, et al., Advanced materials 32 (50), 2004995 (2020)
[8] B. Chen, N. Gauquelin, et al., Nano letters 21 (3), 1295-1302 (2021)
[9] Y.A. Birkhölzer, et al., ACS Applied Electronic Materials 2022, 4, 12, 6020–6028 (2022)
[10] N. Gauquelin, et al., An electron microscopy study of the temperature induced metal insulator transition in VO2, in preparation
[11] N. Gauquelin et al., Nano Lett. 23, 17, 7782–7789 (2023)

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