Recent development in monochromated STEM-EELS : Applications to oxide nanostructures.

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Here, I will discuss about recent developments in monochromatic Scanning Transmission Electron Microscopy and Electron-Energy Loss Spectroscopy (STEM-EELS). At first, I will report how usage of hybrid detectors such as Medipix ot Timepix for EELS combined with Cs-correctors and monochromatic source have allowed new performances such as the collection of core-loss spectra (e.g., Transition Metal EELS $L_{2,3}$ edges) in the milli- to micro-second range, or the detection of near infra-red spectral features with nanometer scale resolution [1].

I will then give few examples on the investigation of oxide nanostructures recently addressed in our laboratory with such developments. The case of $SrVO_3$ nano-structures as a possible new plasmonic materials will be presented, as measured by EELS along with DFT and Maxwell solver simulation [2]. Second example will concern thin film oxides (perovskite based) and notably the case of recently discovered super-conducting (SC) doped-$NdNiO_3$ nickelate [3]. Charge order is an important feature in SC phase diagram and its occurrence in SC nickelate is still debated. I will report its origin as mostly from structural aspects with the presence of quasi-2D sheets of ordered (303) apical oxygen vacancies [4] on top of thin-film grown under certain conditions. In all these examples, STEM-EELS will be combined with synchrotron-based experiment (PES, IXS, RIXS) [5].

[1] Tence M., et al., Microsc. Microanal. 26 (Suppl 2), 2020
[2] Su C.-P., *et al*., *Adv. Opt. Mater.* **11**, 2202415 (2023).
[3] Li D., et al., Nature 572, 624 (2019)
[4] Raji A., et al., *Small*, 2304872 (2023)
[5] Raji A. et al., arXiv preprint arXiv:2308.02855