Valence and core-loss EELS combined to *ab initio* calculations for the rationalization of the electronic properties of nanolaminated conducting ceramics.

V. Mauchamp[1]*, M. Bugnet[2], D. Magne[1], W. Yu[1], V. Gauthier[1], S. Dubois[1] and T. Cabioc'h[1]

[1] *Institut Pprime, UPR 3346 CNRS – Université de Poitiers – ISAE-ENSMA, BP 30179, 86962 Futuroscope-Chasseneuil Cedex, France*
[2] *Department of Materials Science and Engineering, McMaster University, 1280 Main Street West, Hamilton, Ontario L8S 4L7, Canada*

The $M_{n+1}AX_n$ phases (where M is an early transition metal, A an element from the group III-V, and X is C or N), are nanolaminated ceramics which combine the properties of metals and ceramics. As such they are intensively investigated for diverse applications including structural materials for nuclear power plants, high temperature ohmic contacts on SiC, or as magnetic nanolaminates. For all of these applications, the anisotropy of the unit cell and the versatility of their compositions are key parameters to be investigated.

In this context, we combine valence and core-loss EELS with *ab initio* calculations in order to investigate the electronic structure of selected MAX phases (including solid solutions), with controlled crystallographic orientation. Experimental acquisition conditions were optimized from numerical investigations in order to disentangle anisotropy from many-body effects, which significantly complicate the interpretation of the data. The electronic structure of these MAX phases is rationalized in terms of their elementary building blocks. The site projected electron density, as probed in ELNES, is then used to investigate solid solution effects in the electronic transport properties of the $Ti_2AlC_xN_y$ system. EELS data give support to a rather simple *ab initio* approach allowing for the estimation of the relative contributions between charge carriers concentration and electron-phonon coupling effects in the evolution of the resistivity as a function of the composition.