



MORE-MXenes



Magnetically-Ordered Rare Earth MXenes

Coordinator:

- LMGP (Université Grenoble-Alpes), Grenoble, France

(T. Ouisse)

Participants:

- Néel Institute (CNRS, UGA) Grenoble, France

(J. Coraux)

- Université Catholique de Louvain (UCL), Belgium

(B. Hackens)

- Linköping University (LiU), Sweden

(J. Rosen)

+ Drexel University, Philadelphia, USA

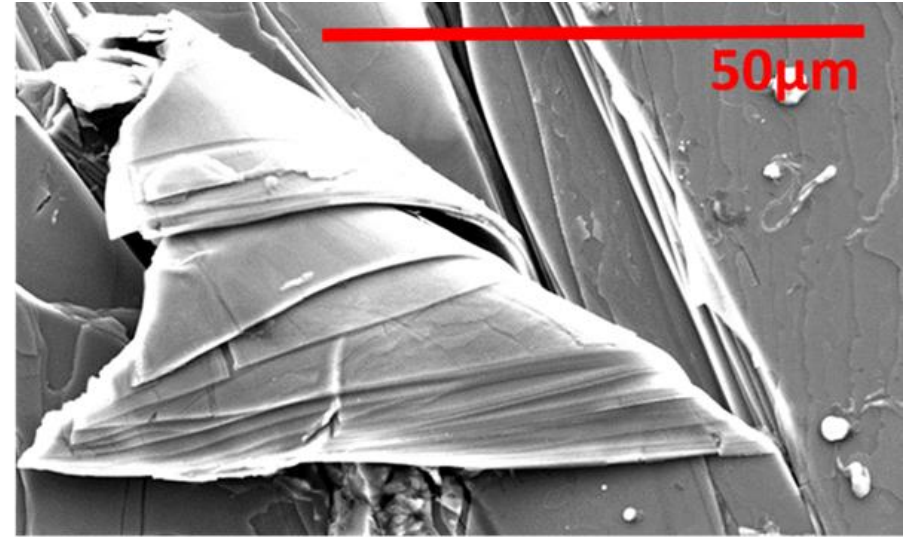
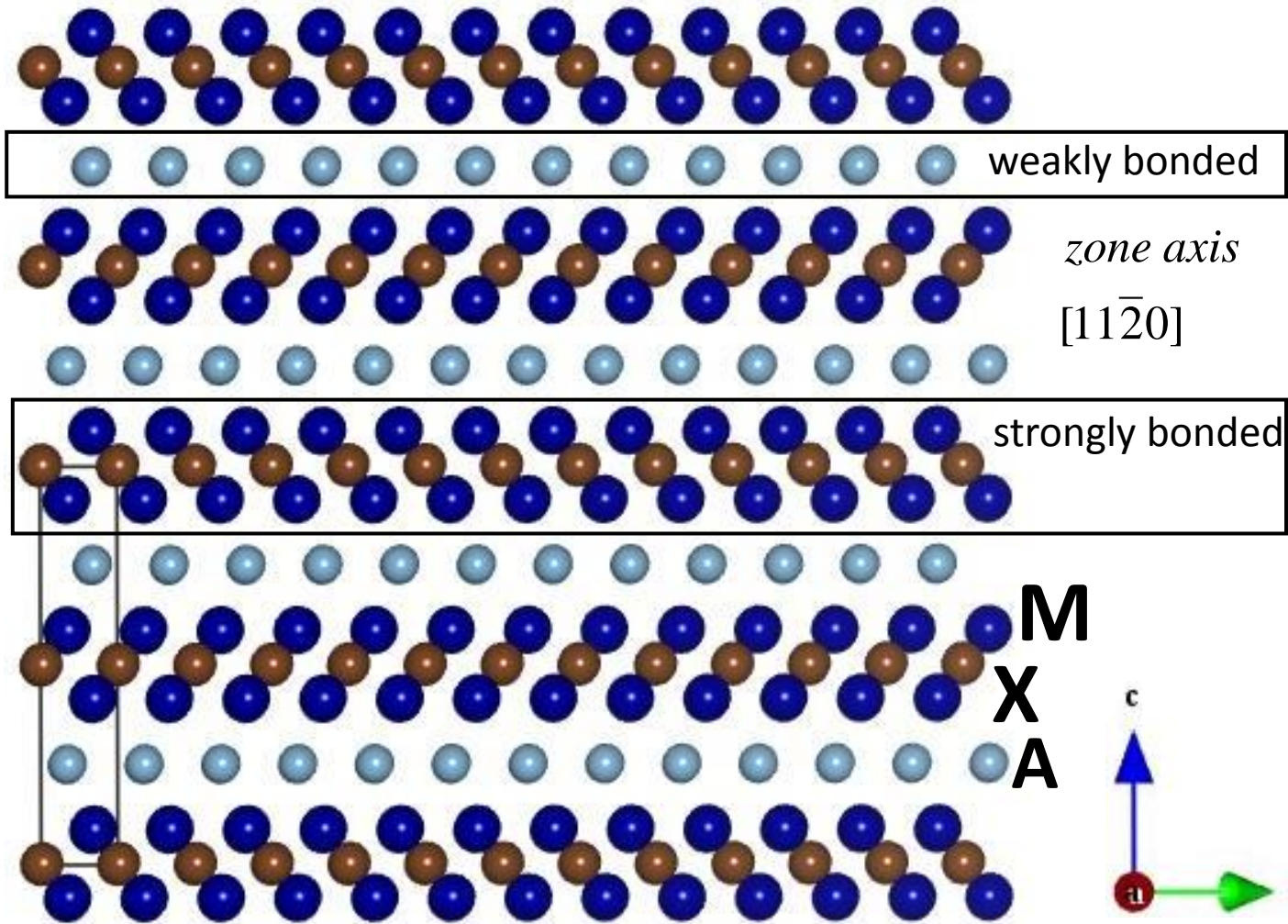
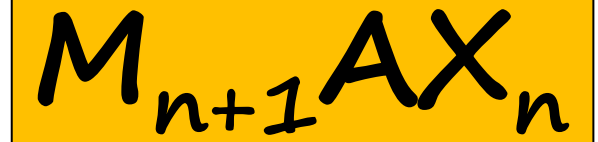
(M.W. Barsoum)

Magnetic MAX phases → Two-dimensional ferromagnetic MXenes for spin injection.

- Understand, at a fundamental level, the electronic and magnetic properties of a new family of magnetic MAX phases in order to fabricate 2D magnetic systems.

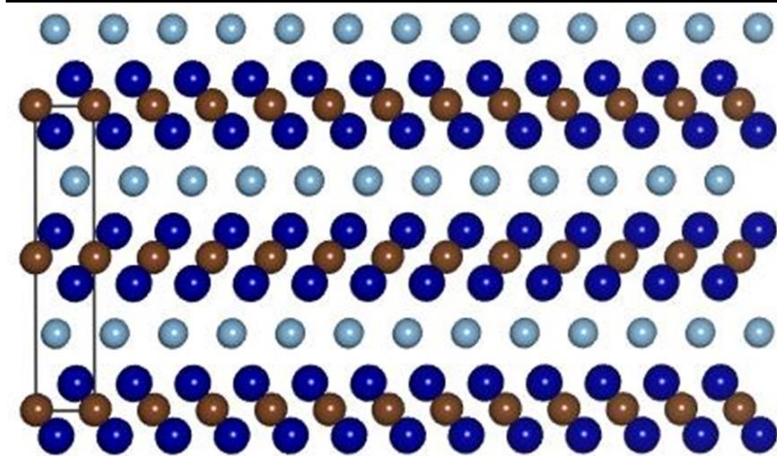
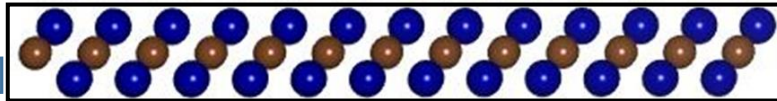
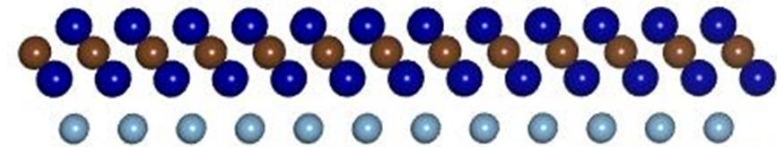


Our books are called MAX phases.

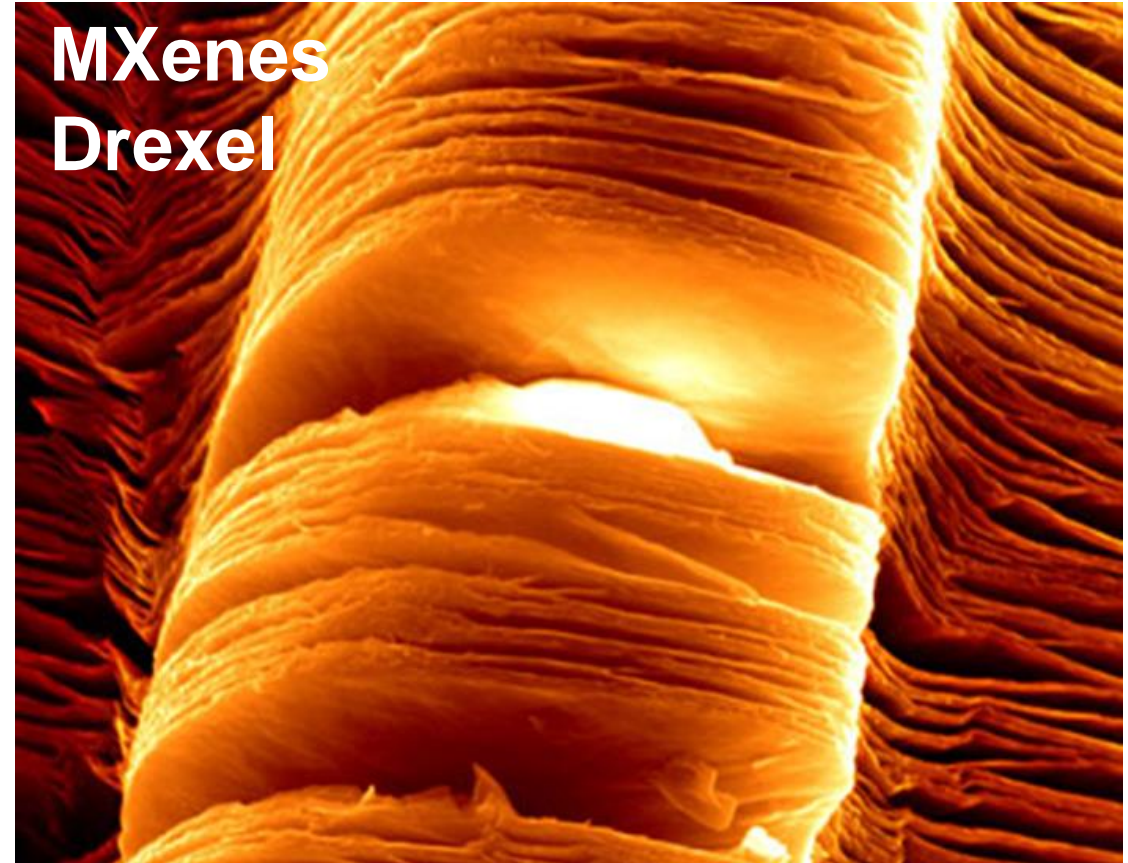
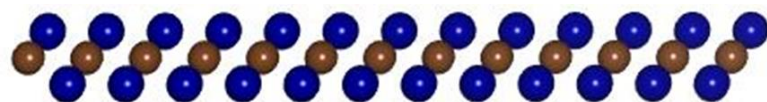


Our pages are called MXenes.

MAX = quasi-2D



MXene = 2D



All MXenes reported to date are hydrophilic 2D metals with a high DOS at E_F .

Our specificity is to start from:

1/ single crystals.

2D M-d electrons+magnetic atoms

« buffer » layer (to be removed)

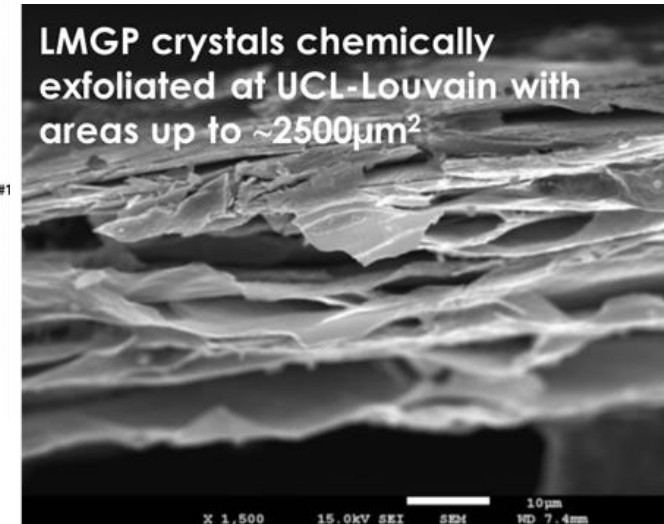
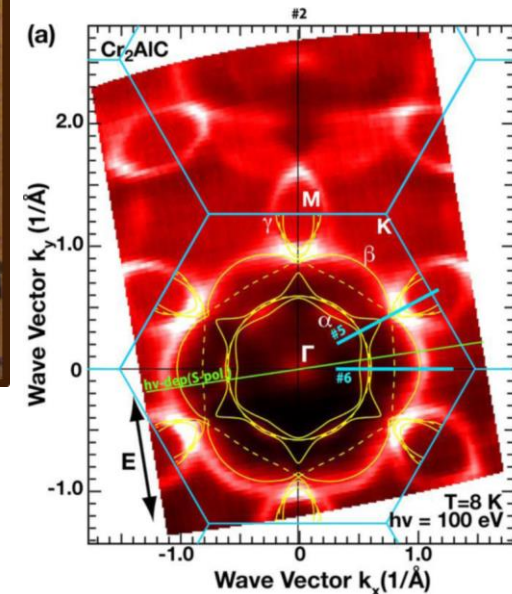
2D M-d electrons+magnetic atoms

« buffer » layer (to be removed)

2D M-d electrons+magnetic atoms

« buffer » layer (to be removed)

2D M-d electrons+magnetic atoms

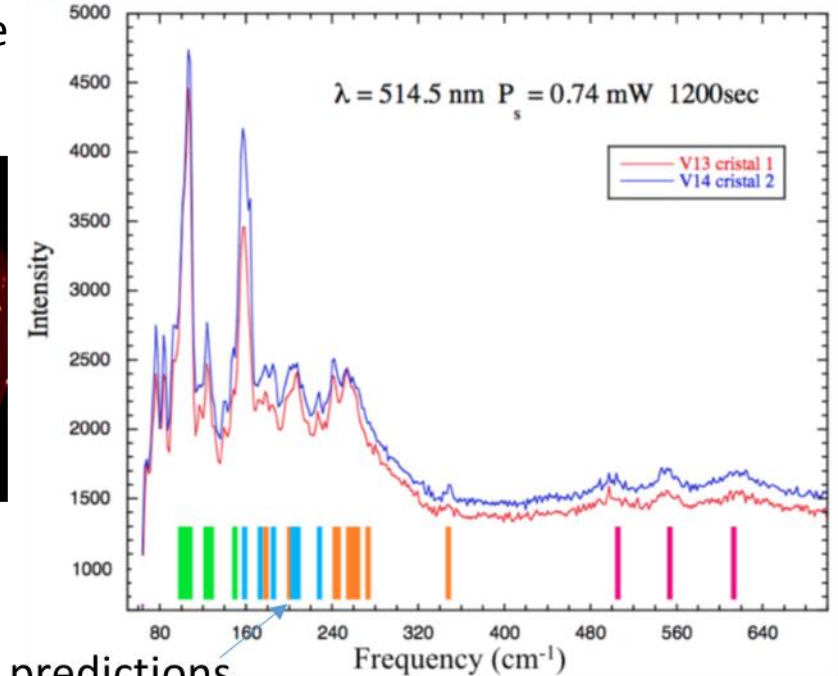
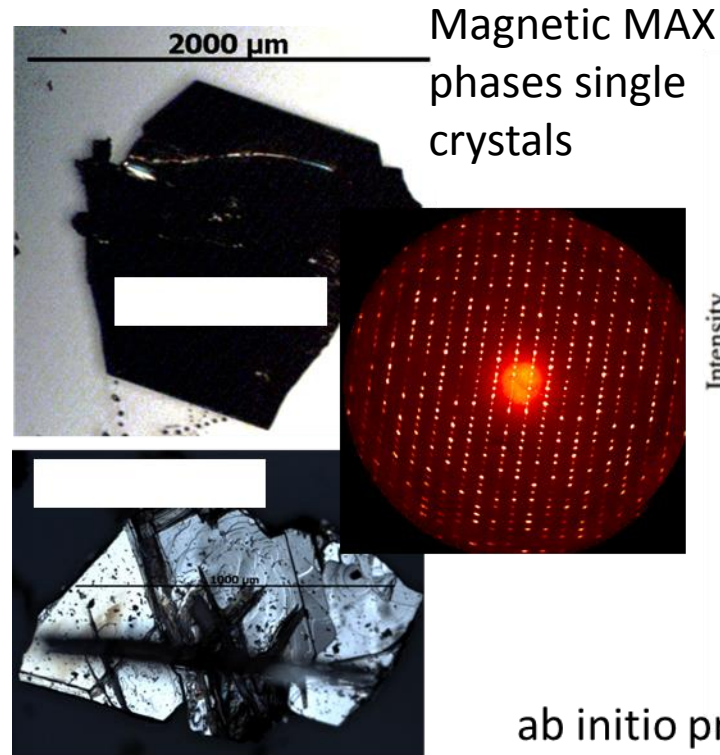
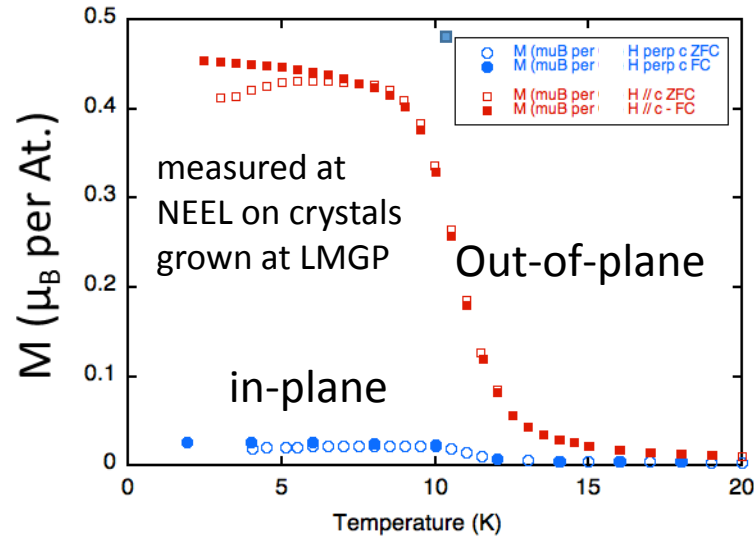


2/ new magnetic MAX phases.

New family discovered and identified at LiU, Linköping in 2017 (to be published in 2018).

Our objectives

2D M-d electrons+magnetic atoms



ab initio predictions
from UCL+Raman spectra measured at LMGP

- Understand, at a fundamental level, the electronic and magnetic properties of a new family of ferromagnetic MAX phases in order to fabricate 2D magnetic systems.
- Play with 2D anisotropy+magnetic interaction range to overcome Mermin-Wagner-Hohenberg theorem in magnetic MXenes.
- Use the magnetism of the RE's to control the spin of the d -electrons at E_F .

Task sharing

LMGP: Crystal growth, chemical exfoliation on crystals, crystal structure, material characterization, physical properties+ coordination...

LiU: Powder synthesis, TEM Microscopy, chemical exfoliation on powders, new phases' stability, crystal structure...

UCL: *Ab initio* DFT and DFPT calculations, magneto-transport, clean room processes, device fabrication...

NEEL: Mechanical exfoliation, clean room processes, surface functionalization, magnetism, XPS, STM, MOKE, device fabrication...

+ Strong interaction with Drexel (M.W. Barsoum) and Clermont-Ferrand (L. Jouffret).

+ Large scale Instruments:

- ILL for powder neutron diffraction (LiU+LMGP, local contact C. Colin).
- ESRF for magnetic dichroism (LMGP, local contact F. Wilhelm).
- Aichi Synchrotron Research center & Nagoya University for ARPES (LMGP, local contact T. Ito).