

Invitation à la soutenance publique de thèse

Pour l'obtention du grade de Docteur en Sciences de l'Ingénieur

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Master of Engineering in Material Physics and Chemistry

From MAX Phases to MXenes: Synthesis, Characterization and Electronic Properties

During recent years, new types of materials have been discovered with unique properties. One family of such materials is two-dimensional (2D) materials with unusual electronic, mechanical and optical properties, which led to their extensive study for diverse applications. Transition metal carbides, carbonitrides and nitrides (MXenes) are among the latest additions to the 2D world, which are derived from their layered precursors, MAX phases, layered early transition metal ternary carbides and nitrides, composed of M, an early transition metal, A, a group A element and X is C and/or N.

In this thesis, as its self-telling title indicated, we present our work on the synthesis, structural characterization and the electron transport in the MAX phases and 2D MXenes.

For MAX phases: using high temperature solution growth and slow cooling technique, several MAX phases single crystals have been successfully grown, including Cr_2AlC , V_2AlC , Ti_3SiC_2 , etc. Structural characterization confirms the single crystalline character of the samples. Experimentally, a set of transport data was obtained from single crystals of V_2AlC and Cr_2AlC as a function of temperature and magnetic field. Theoretically, a general 2D nearly free electron model was proposed for describing the weak field magneto-transport properties of MAX phases.

For MXenes: large scale V_2CT_x (T stands for the surface terminations, hydroxyl, oxygen or fluorine) MXene flakes were successfully synthesized. Mechanical delamination of multilayered V_2CT_x flakes into few layer flakes and transfer on Si/SiO_2 substrate was also achieved. We then detailed the electrical device fabrication and proceeded with electrical measurements down to low temperature, with the aim to extract information on charge carrier behavior. First-hand transport data were obtained on V_2CT_x MXenes, which brings new understandings to this novel type of 2D material.

**Mardi 12 décembre 2017 à
9h30**

Phelma - Minatec Z-108
Grenoble
France



Membres du jury :

Prof. Benoit Hackens (UCL), promoteur
 Prof. Thierry Ouisse (Grenoble INP, France), promoteur
 Prof. Bernard Piraux (UCL), président
 Prof. Jean-Christophe Charlier (UCL), secrétaire
 Prof. Vincent Bayot (UCL)
 Prof. Sylvain Dubois (Université de Poitiers, France)
 Prof. Matthieu Verstraete (ULg)