# AMX2 layered materials (M= transition metal ; X = O, S, Se): from thermoelectrics to multiferroics through 2D metals

**Dr Antoine Maignan**

*Laboratoire CRISMAT, UMR 6508 CNRS/ENSICAEN/UCBN, Caen, France*
*Email:antoine.maignan@ensicaen.fr, website: http://www-crismat.ensicaen.fr/*

**Abstract**

The layered structure of dichalcogenides allows the thermal conductivity to be engineered as in $TiS_2$ [1,2]. For the latter, by intercalating foreign elements such as Cu or Co or Ag between successive $TiS_2$ slabs, it is possible to inject charge carriers and simultaneously reduce the lattice part of the thermal conductivity κ (Fig1). In contrast to Ti, the $CrS_2$ dichalcogenide does not form, but this $CdI_2$-type layer is stabilized in $AgCrS_2$, a multiferroic with a 4SL antiferromagnetic structure [3]. The isostructural selenide, $AgCrSe_2$, though it exhibits a cycloidal magnetic structure, is an interesting thermoelectric. Low temperature inelastic neutron scattering experiments revealed a very low frequency mode at 3 meV, ascribed to large anharmonic displacements of the $Ag^+$ ions in the [Ag]∞ layer. The low thermal conductivity of $AgCrSe_2$ is thus attributed to acoustic phonon scattering by a regular lattice of Ag+ oscillating in quasi-2D potential wells [4]. Interestingly, the oxides derived from the delafossite show similar extreme properties, i.e. 2D metals in the case of $PdCoO_2$ and $PdCrO_2$ [5,6], with large thermal conductivities, or insulating with multiferroics properties for the $CuCrO_2$ antiferromagnet [7].

All these properties illustrate the potentialities of these 2D materials where two layers of different types are naturally intergrown in a 1:1 manner and where the metal network is triangular. In the presentation, a comparison will be made between $AMX_2$ compounds to sort the important features needed for properties enhancement.

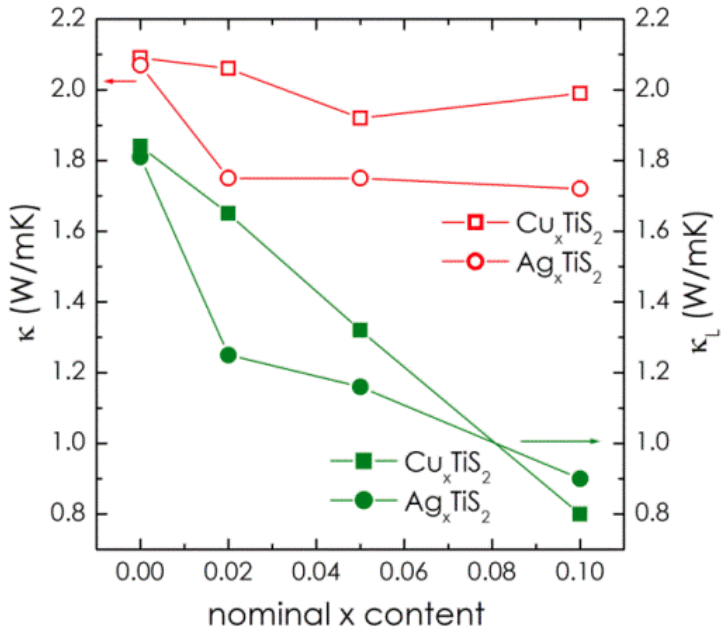


Fig1. Thermal conductivity at 700K (left y-axis) and lattice part of the thermal conductivity (right y-axis) as a function of the nominal content x of Cu (or Ag) according to the $Cu_xTiS_2$ and $Ag_xTiS_2$ chemical formulas.

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**Short Bio/CV**

Antoine Maignan CRISMAT Laboratory, CNRS / ENSICAEN /UNIVERSITE DE CAEN http://www.crismat.ensicaen.fr/index.php
Email: antoine.maignan@ensicaen.fr

Dr. Antoine Maignan, is a CNRS Research Director, Director of the CRISMAT Laboratory. He received his PhD in Sciences in 1988. The CRISMAT laboratory is famous for its discoveries of new transition metal oxides with properties such as high Tc cuprates, CMR manganites, and thermoelectric cobaltites. The research of Antoine Maignan consists in the investigation of strongly correlated systems, showing multiferroics or thermoelectric properties. He has published 644 papers (H index = 64). He has given 122 invited talks at international conferences. Antoine Maignan is member of the European Thermoelectric Society.