Synthesis and characterization of a promising semiconductor: gold-based double perovskites

Ange Bernardin Chambissie Kameni[1], Jean-François GUILLEMOLES [1], Philip Schulz [1], Géraud DELPORT [1],

1 - IPVF, UMR 9006, CNRS, IPVF SAS, Ecole Polytechnique, PSL Université, 18 Boulevard Thomas Gobert, 91120 Palaiseau, France

Contact: geraud.delport@cnrs.fr

Abstract: Double perovskites with the formula $A_2M'M''X_6$ (X = Cl, Br, I) have shown themselves to be promising new materials [1,2] for substituting $APbX_3$-type perovskites as absorber layers in solar cells in order to solve the toxicity problem of these lead-based perovskites. In this family, we are mainly interested in gold-based double perovskites, where the Pb^{2+} atom is replaced by Au^{1+} and Au^{3+} atoms. These gold-based double perovskites in their semiconducting phase consist of alternating octahedra of different volumes with Au^{1+} and Au^{3+} ions at their centers, and are subject to phase transitions (semiconductor to metal) at very high pressures [3].

The main advantage of these perovskites is that they are non-toxic, potentially more stable (due to the presence of gold atoms within the structure) and favorable for photovoltaic applications (gap energy between 1.4 and 1 eV). These materials are difficult to synthesize as thin films, as compared with lead-based perovskites. However, a two-step synthesis method has been developed to obtain thin films (fig1), but has yet to be optimized. In this work, we present the results of the synthesis of these perovskites (mainly $Cs_2Au_2Cl_6$) in the form of thin films and powders, as well as the various Optical (photoluminescence, absorption spectroscopy) and structural (X-ray Diffraction) characterizations.

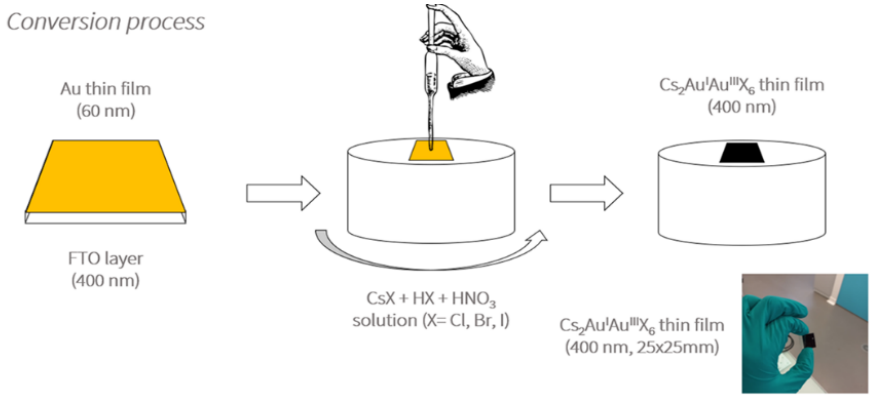

Figure 1 : *Conversion process for the Synthesis of thin films*

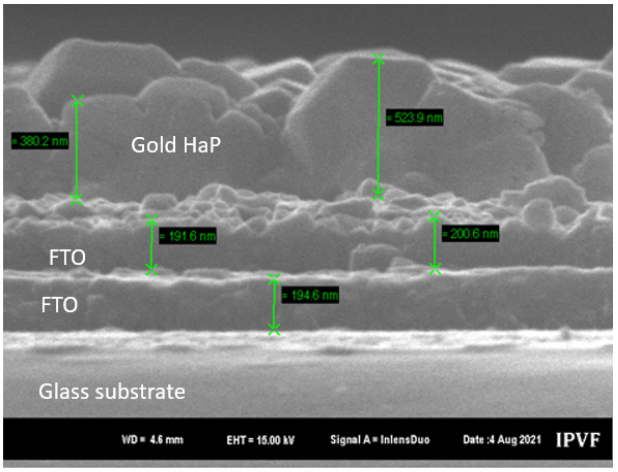

Figure 2 : *SEM image of a thin film sample of $Cs_2Au_2Cl_6$*

References :

[1] S. Vasala and al, *Prog.Solid State Chem*,2015, 43, 1-36.

[2] G. Volonakis and al, *J. Phys. Chem. Lett*, 7, 1254-1259

[3] Pavel Naumov, *Phys. Rev. B* 100, 155113-2019