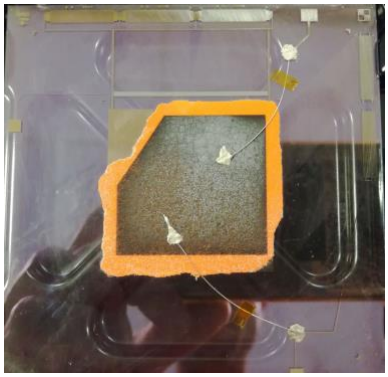
Crystallization of thick polycrystalline layers of hybrid perovskites on pixel matrices: specific opportunities and challenges for direct X-ray detection.

Thibault Lemercier,[1] Jean-Marie Verilhac,[2] Eric Gros D'Aillon,[3] Alain Ibanez[1] and Julien Zaccaro[1]*.
*lead presenter: julien.zaccaro@neel.cnrs.fr
1 Grenoble Alpes University, CNRS, Grenoble INP, Institut Néel, F38042 Grenoble, France
2 Grenoble Alpes University, CEA, LITEN, DTNM F38000 Grenoble, France
3 Grenoble Alpes University, CEA, LETI, DOPT F38000 Grenoble, France

Due to their unique properties, hybrid perovskite materials have attracted huge attention as semiconductors for various applications such as photovoltaics, light-emitting diodes, photo-detectors or X-ray detectors. Regarding the latter application, to absorb most of the hard X-rays used for medical imaging, perovskite layers should have a thickness close to a millimeter, much thicker than photovoltaic applications. Also, the desired surface of the sensor can be quite large (up to 40x40 cm^2) and the substrate present features needed for the formation of the pixels (electrode, TFT…). Together these requirements present a unique challenge for crystallization that belongs neither to epitaxy/thin film deposition, nor to bulk single crystal growth.

Hybrid perovskites are often presented as "easily processable from solutions or inks" and regarding their charge transport properties to be "quite resilient toward defects". While this is mainly true, we will show that their crystallization presents some peculiarities already apparent at the single crystal level [1], and that some open questions remain regarding the correlation between growth conditions and defects impacting their properties [2,3]. In addition, targeting the medical radiography application brings some specific challenges that belongs neither to epitaxy/thin films nor to bulk single crystal growth. The main ones will be presented along with the crystallization strategies we have developed to address them in the course of the European project Peroxis [4].



[1] Amari S, Verihlac JM, Gros-DAillon E, Ibanez A and Zaccaro J. Optimization of the growth conditions for high quality $CH_3NH_3PbBr_3$ hybrid perovskite single crystals. Cryst Growth & Des. 2020;20(3):1665-1672.
[2] Baussens O, Maturana L, Amari S, Zaccaro J, Verihlac JM, Hirsch L and Gros-DAillon E. An insight into the charge carriers transport properties and electric field distribution of $CH_3NH_3PbBr_3$ thick single crystals. Appl. Phys. Lett. 2020;117(4):041904.
[3] García-Batlle M, Baussens O, Amari S, Zaccaro J, Gros-Daillon E, Verilhac JM, Guerrero A, and Garcia-Belmonte G. Moving ions vary electronic conductivity in lead bromide perovskite single crystals through dynamic doping. Adv. Elect. Mat. 2020;6(10);2000485.
[4] European Union's Horizon 2020 research and innovation program under the Photonics Public Private Partnership grant agreement N°871336 for the PEROXIS project (CEA, CNRS, TNO, Univ. Jaume I, Siemens Healthineers, Philips, Trixell).