3-years PhD position at CEA Grenoble
“Single crystal perovskite materials for X-ray imaging”

Context:

State-of-the-art digital X-ray detectors use a scintillating layer, which converts X-rays into light photons, which are then captured by a matrix of photodetectors to form an image. The sensitivity of the signal detection and the spatial resolution of the images obtained are limited, in particular by the use of this scintillating layer. Replacing this layer with a semiconductor detector that directly converts the X rays into electron-hole pairs will increase the measured signal as well as the spatial resolution, thus reducing the dose delivered to the patient, while improving the medical diagnostic. To date, there is no semiconductor material compatible with the large area detectors for medical radiology. Among the emerging materials, hybrid perovskites form a new class of semiconductors potentially compatible with solution process on large area and with remarkable optoelectronic and photovoltaic properties. In this context, CEA LITEN and LETI are undergoing different studies and collaborative projects in order to investigate this new class of materials and its potential for X-ray and gamma ray imaging.

Monocristaux de pérovskite

Objective:

While single crystal hybrid perovskites have demonstrated interesting properties for X-ray detection, their performances still suffer from a high dark current, limited current stability and strong residual signal. Reducing and stabilizing the dark current through a deep understanding and fine-tuning of the crystals elaboration is one of the challenges in the field of perovskite devices.

Based on works and characterizations in progress in the literature and at CEA on the model material $CH_3NH_3PbBr_3$, the PhD student will optimize the growth conditions in order to minimize the electrical (traps) and crystalline defects (dislocations, vacancies) that may lead to degraded performances. The effect of growing condition on material structure, defect density and devices performances will be studied. In parallel, the candidate will investigate new perovskite compositions that could lead to more advanced performances for X-ray detection. Different single crystals will be growth from solution, characterized at the material level (X-ray diffraction, dislocation density, XPS…) and finally at the device level (ToF, current-voltage, photocurrent under X-ray) in a collaborative context with other PhD students.

Environment:

A thesis is in progress since October 2017 in partnership between CEA/LITEN and the Néel Institute from CNRS, on the perovskite crystal growth. This lab has experience in the solution growth of perovskite single crystals and is studying the manufacture of devices from these crystals. In parallel, a second thesis is in progress since October 2018 at the optronic department of CEA/LETI about the characterization of this material for X and gamma ray detectors. An H2020 European project will start in January 2020 about integration of perovskite in X-rays medical flat panel.

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