« *In situ* and *ex situ* characterization of dislocation dynamics in photovoltaic silicon »

Sirine Houam[1], Gabrielle Regula[1], Isabelle Périchaud[1], Guillaume Reinhart[1], Olivier Palais[1], Loïc Patout[1], Fabrice Guittonneau[2], Laurent Barrallier[2], Etienne Pihan[3], Mickael Albaric [3], Benoit Marie[3], Asma Medjahed[3], Nathalie Mangelinck Noël[1]

[1] *Aix-Marseille Univ, Université de Toulon, CNRS, IM2NP, Marseille, France*

[2] *Arts et Métiers Institute of Technology, MSMP, 2 cours des Arts et Métiers, 13617 Aix-en-Provence, France*

[3] *Univ. Grenoble Alpes, CEA, Liten, Campus Ines, 73375, Le Bourget du Lac, France*

Email of the corresponding and presenting author: sirine.houam@im2np.fr

Crystalline silicon is the base of conventional solar cell manufacturing. Several crystallographic defects at different scales (e.g. dislocations and sub-grains) can form during the silicon material fabrication processing including: seed heating, solidification and cooling down.

In our study, we investigate crystalline silicon model samples extracted from ingots fabricated with Czochralski and Cast-mono processes. These samples exhibit cellular dislocation cells. These defects may form either during or after growth, as a result of thermal and mechanical stresses. These model samples are used as seeds in our solidification experiments. Using *in situ* X-ray imaging during solidification (Topography and Radiography), we characterize the behavior of the dislocation cells during seed heating and the dislocation dynamics during silicon solidification. ***Figure 1*** shows X-ray topography images of the sample used as a seed during heating, where dislocation cell walls are highlighted by a dark contrast which can be directly related to areas of high local crystal distortion**.**

Rocking Curve Imaging analysis is also performed on bare wafers extracted from the same ingots to characterize dislocations at the scale of the ingots and to evaluate the impact of this type of dislocations among other type of defects, on the crystal distortions and formation of sub-grains.

Studying this particular type of defects is crucial because they act as recombination centers for minority carriers, thus directly impacting not only the efficiency of solar cells, but also their mechanical properties, as they can serve as initiation sites for cracking. Currently, Micro-Wave phase shift (µWPS) lifetime mapping is being performed on samples from the same ingot to better understand the electrical activity of these defects.

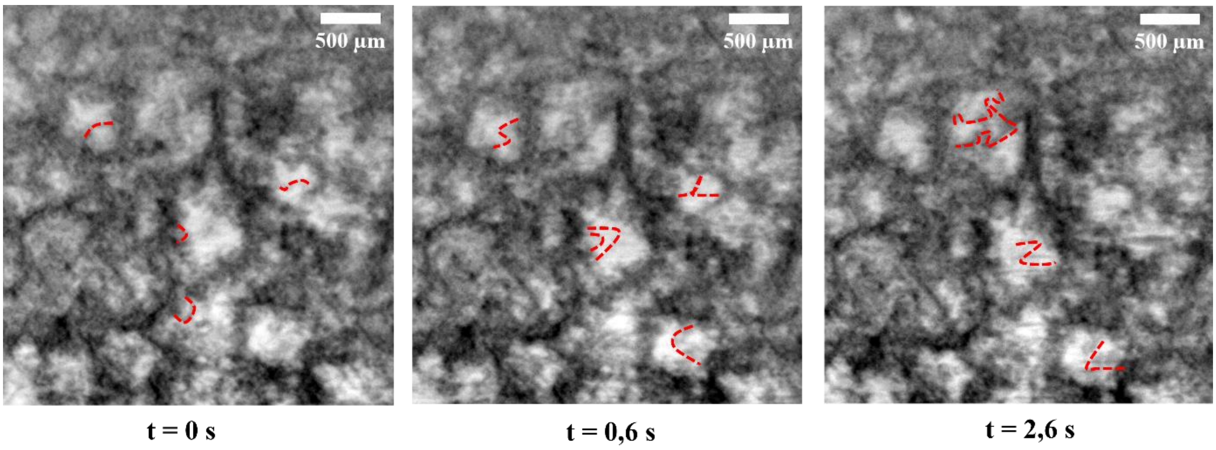

Figure 1*: Topography images of the 220-diffraction spot during heating step showing dislocation dynamics around T ≈ 1330°C; red dotted lines highlight dislocation loops moving inside the dislocation cells.*