Characterization of sub-grain boundaries in Monolike silicon by low temperature spectroscopic photoluminescence

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Monolike silicon is a promising material for Si-based cells, even for advanced cell processes, such as heterojunction, provided that a proper gettering step is applied [1]. This means that the background dislocations present in monolike Si with a typical density of 10^4 cm^{-2} are not efficiency-limiting. However, the local presence of more distorted defects that act as minority-carriers killers is the main performance-limiting factor in the Monolike silicon [2]. 2D extended defects, as sub-grain boundaries (SBGs) domains and grain boundaries, are among these crystalline defects that can be highly active for recombination, especially when decorated with metallic impurities and that can therefore affect the cell performances. The relation between the structures of different types of 2D defects have been previously characterized by EBSD and synchrotron based X-ray topography, and their electrical activities have been analyzed [3].

In the present work, we report on the further characterization of these extended defects using spectroscopic micro-photoluminescence maps (µPL) obtained at liquid helium temperature. The spectra measured are composed of the well-known d-lines emission peaks, related to point defects around dislocations and to dislocations themselves [4], added to the bound (BE) and free excitons (FE) intrinsic radiative recombination peaks. An example of the µPL intensity maps obtained for these different emission peaks is presented on Figure 1 including a new peak at 0.85 eV not yet reported in the published works. These maps show a clear correlation between the µPL intensity distribution and the position of the SBGs determined by EBSD maps. Moreover, D1 (~0,82 eV) and D2 (~0,87 eV) lines are active on different SBGs, depending on the level of the related disorientation while they are usually assumed to have rather he same behavior. The D3 (0.93 eV) and D4 (1.00 eV) lines show the same distribution with some extra features not related with the SBGs positions.

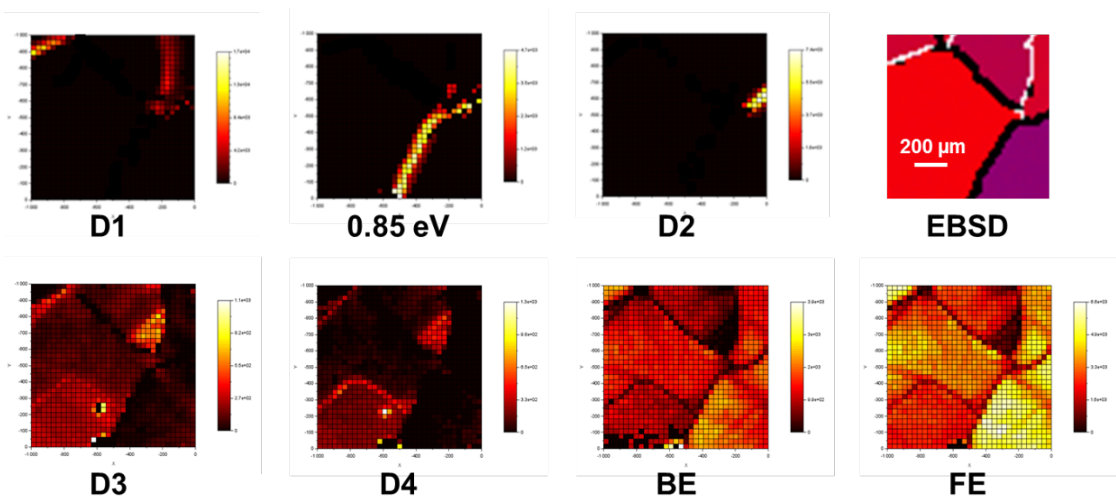

Figure 1: EBSD map and µPL intensity maps for the d-lines, the new line at 0.85 eV, the BE emission and the FE emission, on the same sample area at liquid helium temperature. EBSD: white lines for low angle (<2 deg) disorientation, black lines for high angle (>2 deg) disorientation.

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This work has received support from the Carnot ANR French National Program within the frame of the SiDeRA Carnot project conducted at the "Energie du Futur" Carnot Institute.