Si(100) crystal grains formation by Double-Line Beam Continuous-Wave Laser Lateral Crystallization with Overlapping

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Introduction: Continuous-Wave Laser Lateral Crystallization (CLC) technology with Double-Line Beam (DLB) has been applied to realize the crystallinity of poly-silicon (Si) thin film with the large grain size of over 100x1 μm^2. However, its crystal orientation is typically at (220) in the laser scanning direction and unequally distributed in the laser exposed regions. In order to improve the uniformity of the crystallization and increase the field effect mobility of thin film transistors (TFTs) on Si crystal grains oriented at (100), overlapping irradiation method was developed during the laser annealing process.

Experimental: An amorphous Si of 150 nm thickness and a cap SiO_2 layer of 100 nm thickness were deposited on a quartz substrate by plasma-enhanced CVD. Then, DLB-CLC was employed (wavelength: 532 nm, laser power: 6 W) to crystallize the film. The laser scan was carried out under the scan speeds of 0.5 cm/s, 0.75 cm/s, 0.8 cm/s and 0.85 cm/s with overlapping ratio of 80%. After the cap SiO_2 layer was etched, evaluation of crystal orientation for the film was measured by Electron Back-Scattering Diffraction (EBSD) in 100x100 μm^2 areas and X-Ray Diffraction (XRD) in 1x1 cm^2 areas.

Results and Discussions: Optical micrograph and grain mapping figure of the crystallinity for poly-Si films formed by DLB-CLC with overlapping were shown in Fig 1 and 2, respectively. Figure 1 shows that the poly-Si was crystalized uniformly in the laser scan areas at velocity of 0.8 cm/s. In addition, the linear Si grains with the size of around 100x1 μm^2 were observed uniformly and highly oriented at the (100) at the scan speed of 0.8 cm/s. As the scan speed decreases, area of (100) red region became smaller. The results of XRD measurements are consistent with these results. From this result, high performance TFTs with a high uniformity would be achieved on this poly-Si thin film.

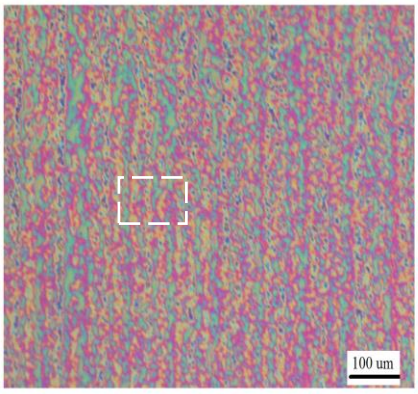

Figure 1: Optical micrograph of the DLB-CLC-ed poly-Si with overlapping (power: 6 W, scan speed: 0.8 cm/s)

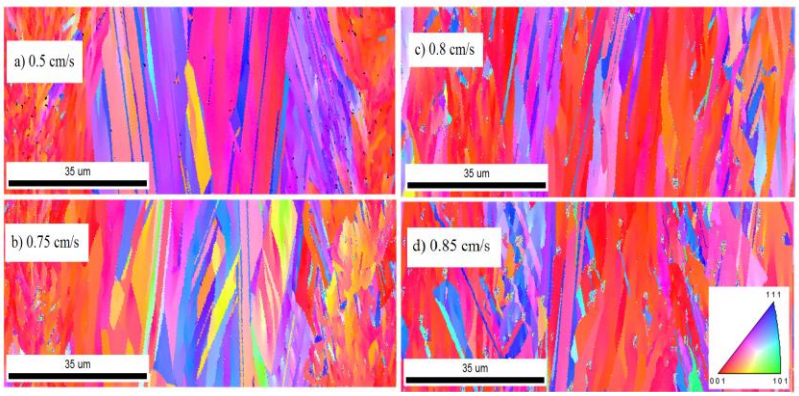

Figure 2: Grain mapping of poly-Si films crystallized by DLB-CLC with overlapping by EBSD (power: 6 W). Scan speeds are shown in these figures.

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