Preferred <100> surface and in-plane orientations in self-assembled poly-Si by multiple excimer laser irradiation

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Clear preference of <100>- orientation in self-assembled poly-Si is observed for the first time not only in surface, but also in in-plane orientations. This textured poly-Si can be used for TFT active channel, expecting a high performance with an excellent uniformity.

By multiple excimer laser irradiation to 30 nm thick α-Si film, laser induced periodic surface structure (LIPSS) is developed due to a linearly polarized laser light. As indicated in Fig. 1, square-shaped grains with a grain size of approximately 300 nm are aligned in a line with a diagonal direction in the wafer with self-assemble manner. ,

Strong preferred orientation of <100> was observed in surface orientation as shown in pole figure and inverse pole figures of Fig. 2. In the pole figure, it can also be seen that other 4 <100> directions are perpendicular to the 4 sides of the square shaped grains. This means that the in-plane orientation is also preferred with <100>. In our knowledge, this strong preference of the in-plane orientation has never been reported so far in poly-Si grains formed on amorphous substrate.

The strong preference for <100> orientation in both surface and in-plane was observed in poly-Si within a wide laser energy window, ranging from 255 mJ/cm^2 to 275 mJ/cm^2.

This texture could be explained by the alternate melting and solidification during the LIPSS formation. During the alternate melting and solidification, the <100> orientated grains grow fastest and can be selected during the hundreds of melting-solidification cycles.

This textured poly-Si film will be used as a seeding layer, combined with μ–Czochralski(grain filter) process[1], to prepare the orientation and location controlled grains. TFTs fabricated in such grains should have a superior performance.

Reference:
1: P. C. van der. Wilt, B. D. van Dijk, G. J. Bertens, R. Ishihara and C. I. M. Beenakker, Appl. Phys. Lett. **79** (2001) 1819.

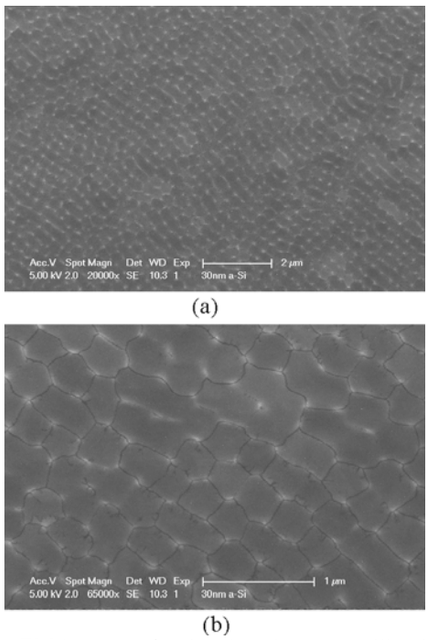

Fig. 1 SEM images of poly-Si grains, crystallized at 260 mJ/cm^2 after 500 shots: (a) periodic grain boundaries; (b) self-assembly square-shaped grains.

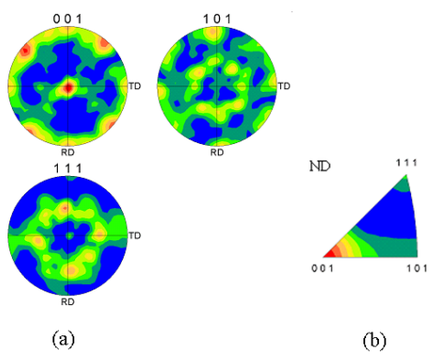

Fig. 2 EBSD measurement of 300 grains in the figure 1: (a) <100>, <110> and <111> pole figures; (b) Inverse pole figure of surface normal direction (ND).