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Annealing effects of initial amorphous ZnO layer on structural and the optical properties of ZnO thin films grown by plasma-assisted molecular beam epitaxy

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ZnO thin films were grown on p-type Si (100) substrates by plasma-assisted molecular beam epitaxy (PA-MBE). Prior to the growth of low-temperature (LT) ZnO buffer layer, the amorphous ZnO layer was grown at 150 ℃ Then the amorphous ZnO layer was thermally annealed at temperature ranging from 600 to 900 ℃ After thermal annealing of the amorphous ZnO layer, the LT-ZnO buffer layer and ZnO thin films were grown at 350 and 600 ℃ respectively. The annealing effects of initial amorphous ZnO layer on structural and optical properties of ZnO thin films have been investigated by atomic force microscopy (AFM), scanning electron microscopy (SEM) and photoluminescence (PL). From AFM and SEM results, surface morphology of the samples was changed by thermal annealing of amorphous ZnO layer. With increasing crystallization temperature from 600 to 800 ℃ the PL intensity ratio of the near-band edge emissions (NBEE) to the deep-level emissions (DLE) was decreased, but the PL intensity ratio of the NBEE to the DLE was increased at a temperature of 900 ℃.