Direct Deposition of Polycrystalline Silicon Films on Plastic Substrates using the Catalytic CVD Technique

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Polycrystalline silicon films were directly deposited on polyethersulfone (PES) substrates, initially held at room temperature, by using the catalytic chemical vapor deposition (Cat-CVD) technique. The influence of various process parameters for the as-deposited polycrystalline silicon was investigated. Temperature of the tungsten catalyst and the concentration of hydrogen in the source gas were determined to be two major parameters that influence the crystallinity of the as-deposited film. The radiation from the filament heated up the substrate, but the temperature of the substrate surface was controlled below 190°C, so as not to damage the PES substrates. Raman scattering spectroscopy and UV reflectance spectroscopy showed that the characteristic peak intensity for the crystalline phase was greater than 50% of that of a single-crystal wafer. X-ray diffraction and transmission electron microscopy analysis showed that crystallites have a columnar structure with a preferred orientation of (111). The as-deposited films also have a low hydrogen content (<1.5 atomic %) and a high deposition rate (~30Å/sec). The polysilicon films that were prepared directly by the Cat-CVD could dispense with the additional crystallization process, and could be a good candidate for thin film transistor materials of flexible active matrix display devices.