Microstructure and Electrical Properties of LPCVD Polysilicon

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The microstructure and electrical properties of polysilicon films deposited by low pressure chemical vapor deposition on silicon dioxide have been investigated as a function of deposition condition and As doping concentration. The deposition temperature was varied from 560°C to 625°C, and the As doping concentration from 1 x 10^{17} to 5 x $10^{20}/cm^3$. The polysilicon films deposited at 625°C and annealed at 900°C have an average grain size of 200-300 Å and a rough surface with columnar grain structure, while the film deposited at 560°C followed by the 900°C anneal have 1000 Å grains and smooth surfaces. For the same As doping concentration, the conductivity and Hall mobility of the polysilicon deposited at 560°C are larger than those of the polysilicon deposited at 625°C, due mainly to less grain boundary trapping. The grain boundary potential barrier decreases from 0.063 eV in films with As doping concentration of 5 x$10^{18}/cm^3$ to 0.0001 eV in films doped to 2.5 x $10^{20}/cm^3$. The trap density of the grain boundary, however, is almost independent of the deposition conditions and the values are determined to be 3.6-5 x$10^{12}/cm^2$.9