# On the Carrier Concentration of Nanocrystalline Si:H Films Made by Inductively Coupled Plasma with Low-Inductance Antenna

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Hydrogenated nanocrystalline silicon (nc-Si:H) film is attractive for photovoltaic applications, as compared to its amorphous counterpart (a-Si:H), due to its spectral response at longer wavelengths, higher doping efficiency, higher mobility, and higher stability against light soaking. In order to manufacture such solar panels at a high enough rate using a plasma-enhanced chemical vapor deposition (PECVD) process, a higher plasma density and a larger yet uniform plasma zone are thus advantageous. Many methods have been proposed to generate such high-density plasmas, and in this study, an inductively coupled plasma (ICP) system using arrays of internal low inductance antennas (LIA) is employed to produce large-area, highly crystallized nc-Si:H films. P-type nc-Si:H thin films are prepared on a glass substrate by such a system with $SiH_4$, $H_2$ and $B_2H_6$ as the precursor gases. Both $C_H$ and R ratio decrease with increasing substrate temperature. The XRR density, GIXRD grain size, and electrical conductivity all consistently increase with substrate temperature. The $X_C$ increase with substrate temperature until 300?,and then decrease with increasing substrate temperature .The boron concentration is measured by SIMS, and appears unaffected by substrate temperature at around $10^{20}$ atoms/cm$^3$, but the carrier concentration increase with substrate temperature from $10^{18}$ to $10^{20}$ cm$^{-3}$.The reason is explained by the breakdown of B-H complex.