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Electrical investigation of the effect of gas additives on silicon deposition plasmas M. SOBOLEWSKI, NIST, R. RIDGEWAY, M. BITNER, P. HURLEY, D. SINATORE, Air Products — Silane/hydrogen plasmas are used to deposit layers of amorphous and microcrystalline silicon for thin-film solar cells. One way to potentially increase deposition rates and reduce manufacturing costs is to add small amounts of other silicon-containing gases. Such gases, however, may be highly electronegative and may affect the absorption of power by the plasma. Thus, it is difficult to distinguish the chemical effects of each additive from its electrical effects. To investigate such effects, experiments were performed in a capacitively coupled Applied Materials P5000 plasma deposition chamber. Current and voltage probes were mounted on the powered electrode and the stray impedance of the electrode was characterized, allowing accurate determination of the true power absorbed by the discharge. A sheath model was used to distinguish the power absorbed by electrons in the plasma from that absorbed by ions in the sheaths. The power coupling efficiency and the fraction of power absorbed by electrons both fell off sharply at low values of the pressure, power, or electrode gap. For the rest of the experimental conditions, the power coupling and utilization efficiencies were high and nearly constant, indicating that, there, the effect of additives on growth rates is primarily a chemical effect. This work also led to the identification of an electrical signal that indicates growth of the microcrystalline phase.

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