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SiH4-H2-Plasma Modeling of the deposition of μc-Si:H Solar Cells
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— The correlation between plasma properties and characteristics of thin film silicon solar cells is relatively unknown. As a result, university researchers use numerous plasma sources for deposition of microcrystalline silicon by Plasma Enhanced Chemical Vapor Deposition (PECVD). Within industry, Capacitive Coupled Plasma (CCP) has been established as the standard source. It is known that different plasma species induce different performance properties in solar cells. This work seeks to establish this relationship between plasma chemistry and solar cell characteristics. In a preliminary analysis, the chemical reactions of SiH4-H2 were modeled in order to investigate the μc-Si:H deposition characteristics of different plasma sources. Using a global model, the ideal plasma regime for high-quality solar cells was determined with respect to electron density and temperature. To complement this model, CCP discharge was specifically analyzed using a fluid model from the commercial tool CFD-ACE+. These results were validated against experimental data for growth rate and SiH4 depletion from literature. The chemical plasma composition responsible for μc-Si:H layers was investigated and correlations were developed between measured cell efficiencies and simulated plasma species.

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