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Arc plasma assisted purification of metallic silicon for solar cells: numerical modeling and real time process monitoring JUNGHOON JOO, WONKYUN YANG, Department of Materials Science and Engineering, Kunsan National University, BO-YUN JANG, YOUNG SOO AHN, Korean Institute of Energy Research — For achieving the grid parity in solar cell business, cheaper materials and processing technology are necessary. Thin film solar cell could be a strong candidate. Ribbon type polycrystalline solar cell may be a low cost solution with much simpler equipments: melting and specialized casting devices. For further reduction of the manufacturing cost, device grade of silicon starting material (99.99999%) should be replaced with cheaper substitute without degrading the solar conversion efficiency. To reduce the complicated chloride based purification steps, simple vacuum arc melting and purification are considered. It is using small amount of reactive gases (hydrogen or water vapor) under certain plasma conditions to remove B and P through formation of highly volatile oxides and hydrides. Due to the low electrical conductivity of metallic grade silicon, non-transferrable arc operation mode was selected. We used 3D CFD based numerical modeling to optimize the process conditions; arc to silicon pool distance, plasma power input and reactive gas mixing ratio. As a real time monitoring technique, QMS and OES were used to detect any volatile species related with impurities during melting and purification steps.

Junghoon Joo

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