

# Abstract

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## **Chemical-Vapor Deposited Large-Area Multicrystalline Epitaxial Silicon Solar Cells on Upgraded Metallurgical Silicon/Graphite Substrates**

Very large-area (200 cm<sup>2</sup>) thin multicrystalline silicon sheets having large grain size were produced directly on graphite by unidirectional solidification of acid-leached and gettered metallurgical silicon powder. The metallurgical silicon powder was acid treated by refluxing in aqua regia for several days and then gettered in air with P<sub>2</sub>O<sub>5</sub> at 1050°C for 3–5 days. After cleaning and drying the acid-treated and gettered silicon, it was uniformly spread on top of a graphite boat, Radio-frequency (RF) heated to melt and then unidirectionally solidified to form a polycrystalline substrate. This resulted in an n<sup>+</sup> substrate having a resistivity of about 0.03 Ω cm. P–N junction solar cells were formed by the epitaxial deposition of n- and p-layers using the hydrogen reduction of trichlorosilane. Front grid contact was formed by vacuum evaporation of Ti and Ag. Solar cell characterization results are very promising. This substrate preparation technique is cost-effective, produces low-cost flat rectangular and mechanically strong multicrystalline silicon substrates, suitable for the continuous large-volume production of solar cells.