

PROCESS ECONOMICS PROGRAM

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Abstract

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HIGH-PURITY SILICON

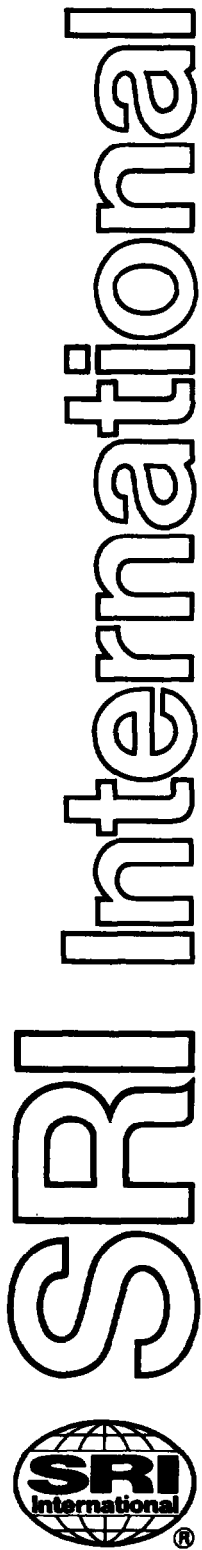
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This report summarizes the technology and economics of producing high-purity silicon ("polysilicon") suitable for making single-crystal silicon for semiconductors or photovoltaic cells. In the commercial processes, the raw material--metallurgical-grade silicon--is converted to trichlorosilane (TCS), which is purified and then decomposed to high-purity silicon.

In the Siemens process, TCS is made by reacting metallurgical-grade silicon with hydrogen and SiCl_4 in a two-stage vapor-phase reaction in a fluidized bed. The TCS is purified by distillation and is decomposed at 1125°C in the presence of hydrogen. Purified silicon is deposited on heated filaments in a bell-jar reactor.

In an alternative process, practiced commercially by Union Carbide, TCS is converted to silane (SiH_4) by disproportionation. Chlorosilanes are recycled, and purified silane is decomposed at 805°C . Purified silicon is deposited on heated filaments in a bell-jar reactor. According to our analysis, this is a more expensive process.

Other processes for making high-purity silicon are now under development. Some of them use other intermediates such as SiF_4 or SiBr_4 .



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HIGH-PURITY SILICON

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