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Silicon ingot maker Solaicx customizes gear for solar

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PORTLAND, Ore. — Solar cell ingot manufacturer Solaicx has developed its own manufacturing process for wafers used in solar panels. The result, it claims, is much higher solar conversion efficiencies.

Solaicx's efforts to differentiate itself from traditional manufacturers of silicon ingots for solar applications has resulted in its receiving the Progressive Manufacturing 100 award for its proprietary manufacturing process. The process for crystalline silicon photovoltaics was cited for consistently high efficiency.

The company's Progressive Manufacturing Award was in the "Innovation Mastery" category.

"Everybody else grows silicon ingots for the solar industry using production equipment that was designed for the semiconductor industry," said Solaicx co-founder John Sedgwick. "What we did was design unique, proprietary equipment that solves the wants and needs of solar industry."

Solaicx claims it is often approached about licensing its ingot-growing process but has so far declined, sticking with its business model as the exclusive manufacture of its ingots. The ingots are cut into wafers for solar cells.

Solaicx has an facility in Santa Clara, Calif., but does all its manufacturing at its facility here, where 12 growers now produce 60

megawatts of solar cell material annually. The company has additional space available to expand to 48 more growers, bringing maximum capacity to 300 megawatts annually by 2010.

Most silicon ingots are manufactured using growers designed for the chip industry, where the cost of the semiconductor wafers derived from that ingot is insignificant compared to the cost of chips. Hence, chip makers do not optimize productivity or the cost of growing silicon ingots.

For solar, a wafer is essentially single, large photovoltaic diode. Consequently, wafer cost is a huge part of the end product. To meet those needs, Solaicx optimized its manufacturing facility to grow only ingots for the solar industry.

"We went back to basics and designed a machine which removed every cost from the ingot growing process that was not related to the solar industry," said Sedgwick. "As a result, our machines manufacture ingots for the solar industry better, faster and cheaper than semiconductor growers can."

The major problem solved by Solaicx was ingot uniformity. Semiconductor ingot growers, when used for making solar cell wafers, have a resistivity that changes from one end of the ingot to the other. As a result, wafers cut from the ingot must be sorted based on their ability to convert sunlight into electricity. Solaicx claims its ingots can be sawed into wafers that uniformly produce solar cells of the highest possible efficiency.

In a traditional IC ingot grower, silicon and its dopants are melted in the bottom crucible. A seed is then lowered into the grower so that it just touches the molten mixture. As the molten material crystallizes on the bottom of the seed, it is slowly pulled upward. After about 12 hours, a pure, single-crystal ingot several meters long and either 6- or 8-inches in diameter is produced. The ingot is then cut into 100- to 300-micron-thick wafers, the major component of a solar cell.

The problem with this method for the solar industry is that as the ingot is grown the silicon-to-dopant ratio changes. This causes the resistivity of the resulting wafers to increase from one end of the ingot to the other.

Solaicx claims it solved the problem by constantly feeding silicon and dopant into the crucible as the ingot grows, thereby maintaining a constant ratio throughout the entire growing process. Hence, wafers cut from its ingots have a more consistent resistivity that boosts solar efficiency.

"The level of impurities ordinarily gets higher as you pull an ingot out of the molten silicon," said Sedgwick. "But with our process we are continuously feeding fresh silicon and dopant into the crucible under computer control to keep their ratio the same throughout the entire run."