

**Effects of the refractive index of light concentrators on their optical concentration ratio**

by

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## ABSTRACT

This study reports on photovoltaic (PV) cells encapsulated with silicones having different refractive indices, as well as unencapsulated PV cells. In concentrator photovoltaic systems (CPV systems), the sunlight is concentrated on the PV semiconductor cell. The concentration ratio is defined as the entrance aperture area divided by the chip area. It is demonstrated that the concentration ratio of CPV systems can be increased by using a high-refractive-index encapsulant. The measured short-circuit photocurrent of an AlGaInP PV cell having a dome-shaped high-refractive-index encapsulation ( $n = 1.57$ ) is 71% higher than that of the PV cell having a low-refractive-index encapsulation ( $n = 1.41$ ), and 316% higher than that of the unencapsulated PV cell. Experimental concentration-ratio enhancements are well-matched to the calculated as well as the simulated concentration-ratio enhancements that are based on a high refractive index of the PV concentrator. Furthermore, CPV systems with different chip-to-encapsulation-top distances are also fabricated. The encapsulant is used to focus the light onto the semiconductor chip. The measured photocurrent indicates that the concentration ratio would increase with the chip-to-encapsulation-top distance among the four chip-to-encapsulation-top distances our mold could provide. Simulated and measured results showed a similar and consistent trend.