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The Environmental Impact of Advanced Material Concepts for Luminescent Solar Concentrators

Mihai ANGHEL, Violeta NICULESCU, Ioan STEFANESCU

National Research and Development Institute for Cryogenics and Isotopic Technologies – ICIT, 4th Uzinei Street, 240050, Ramnicu Valcea, Romania; mihai.anghel@icsi.ro

SUMMARY

Sunlight that is incident on the front surface of a luminescent solar concentrator (LSC) is absorbed and subsequently re-emitted by luminescent materials. The resulting luminescence is transported to the edge of the LSC sheet and concentrated onto photovoltaic devices. This paper outlines the loss mechanisms that limit conversion efficiency of the LSC and highlights the role that advanced materials can play. Losses include nonunity fluorescence quantum yield (FQY), reabsorption losses, incomplete utilization of the solar spectrum, and escape cone losses. Long-term photostability is also discussed as it is essential for commercial feasibility of any solar technology. The main motivation for implementing an LSC is to replace the large area of expensive solar cells required in a standard flat-plate PV panel, with an inexpensive polymeric collector, thereby, reducing the cost of the module (in dollars per watt) and also of the solar power (in dollars per kilowatthour). A key advantage of LSC technology compared to other concentrating systems is that it can collect both direct and diffuse solar radiation. This means that tracking of the sun is not required—enhancing further potential cost reductions and making LSCs excellent candidates for building integrated photovoltaics (BIPV)—as well as making them the ideal PV technology for cloudier northern European climates. Similarly to electricity conversion, LSCs also have applications in daylighting (Hiramoto *et al.,* 1991), thermal conversion, and hybrid thermal–photovoltaic systems that could generate electricity and extract the heat generated by the LSC plate (Xue *et al*., 2005).

Keywords: environment, fluorescent, luminescent, photovoltaic (PV), quantum yield, solar concentrator.

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