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Optimum Luminescent Solar Concentrators¹

HERMILO HERNANDEZ-NOYOLA, DAVID POTTERVELD, ROY HOLT, SETH DARLING, GEORGE CRABTREE, Argonne National Laboratory — In this paper is presented a numerical optimization analysis of a luminescent solar concentrator (LSC). This optimization was made by implementing a genetic algorithms subroutine in the numerical ray-tracing Monte Carlo model, SIMSOLAR-P. The results from this study provide a theoretical upper limit to the performance of any LSC, and give guidance for the luminescent properties required of quantum nano-crystals to be used in a LSC. The computational time among Monte Carlo calculations has been efficiently reduced in the LSC simulator, by a master-slave parallel implementation featuring the Asynchronous Dynamic Load-Balancing library (ADLB) FORTRAN interface to the MPI parallel programming core. The initial use of the optimization is to determine the optimal parameters of a hypothetical “perfect dye” that obeys the Kennard-Stepanov (K-S) thermodynamic relationship between emission and absorption. Results will be presented for three LSC configurations: a single layer with a perfect dye, a tandem system of two optimized layers with perfect dyes (analog of a tandem solar-cell) and a two layer system featuring an organic dye in the first layer and an optimized perfect dye in the bottom layer.

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Hermilo Hernandez-Noyola
Argonne National Laboratory

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