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HIGH-PERFORMANCE ORGANIC SOLAR CELLS

Abstract.

The goal of this project is to develop materials and methods that will boost the efficiency of Organic Solar Cells suitable for low cost, high performance alternative energy generation systems. This goal will be achieved by making layered structures, consisting of organic semiconductor, charge-extraction electrodes, and field-enhancement ferroelectric nanostructures. The project plan is to couple detailed random-walk diffusion modeling with the fabrication and measurement activities to tailor the composition and nanostructure so as to optimize device performance. The research team, which is led by PIs Ducharme, Huang, and Cole, has the essential expertise and facilities necessary to achieve this goal. Our preliminary results, which were recently published in the premier journal Nature Materials, were a proof-of-concept demonstration of the value of incorporating ferroelectric nanostructures into an organic solar cell by increasing the energy efficiency of a conventional organic solar cell threefold. This remarkable achievement established the viability and great promise of our approach. The proposed research project will enable our team to carry out the exploratory studies necessary to make this project a prime candidate for funding by, e.g., the Department of Energy, the National Science Foundation and Industry. PI Stephen Ducharme in the Department of Physics and Astronomy is the co-discoverer and leading expert on self-assembled ferroelectric polymer nanostructures. Co-PIs Jinsong Huang and Kevin Cole in the UNL Department of Mechanical Engineering are leading researchers specializing in, respectively, organic semiconductor devices and, modeling of diffusion processes in semiconductors.