International Doctoral Program in Science Fellowship

Establishing microscopic photophysics in hybrid perovskite solar cells

Background and motivation

The world-increasing demand of clean energy is pushing towards the production of low-cost and efficient solar cells. To overcome silicon-based technology, new materials have emerged such as hybrid perovskites, a mixed organic-inorganic compound. Hybrid perovskites such as $MAPbI_3$ ($MA=CH_3NH_3^+$) and mixed halide perovskites such as $MAPb(I_{1-x}Clx)_3$ and $MAPb(I_{1-x}Br_x)_3$ represent intriguing materials since in just 5 years the power conversion efficiencies matched those of silicon. Despite this, there still exists a dearth of microscopic insight into solar cell performance beyond simple device-level metrics. Major issues are:1) to unveil the microscopic photophysics of the material, linking device performance to local electronic disorder originating from cation/anion phase segregation; 2) the long-term stability of hybrid perovskites, that are susceptible to dynamic transformations linked to ion migration, involving both cations and anions.

We are therefore developing spatially-resolved optical techniques that will enable us to study the microscopic photophysics of hybrid perovskite materials. The project we are seeking a student for centers on linking device performance to local electronic disorder originating from cation/anion phase segregation. This will involve direct optical measurements of perovskite thin film as well as solar cell absorption and emission. It will also entail use of a superresolution infrared absorption technique called photothermal heterodyne imaging to directly image for the first time cation migration under applied bias.

Profile

- Master's degree or similar qualification in Physics, Materials Science, Chemistry or adjacent fields.
- A solid background in physics, materials science or materials chemistry is required.
- Experience in optics, microscopes and home-built instrumentation will be considered as an advantage. Programming skills, for example in Python, are also desired.
- Good knowledge of the English language, both spoken and written, is essential.
- Strong commitment, ability to work in a team, and eager for international mobility is desired.

Opportunities

- Experimental research participating to the international collaboration between research groups USA and Italy. **Double degree opportunity. The position is available immediately. Student stipend at the University of Notre Dame is currently $30,448 before tax. Health insurance is provided at no cost.**

Supervisors

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