## FLORIDA STATE UNIVERSITY

### *Planning Grant: Hydrogen storage using carbon-based adsorbent materials*

**PI:** Efstratios Manousakis

**Description:** We propose to theoretically investigate a variety of carbon based nano-porous materials, such as activated carbon or single-wall or multi-wall carbon nanotubes, which can be used to store and transport hydrogen. We find that by doping with metallic elements, the micro-surfaces of these carbon-based porous materials provide increased van der Waals forces to the adsorbed hydrogen molecules; this effect significantly enhances the volumetric energy density for hydrogen storage and we propose to carry out a full theoretical investigation to find the optimum conditions.

**Budget: $15,000**

## Progress Summary

As a result of the realization that the originally proposed project has low funding priority we have recently turned our attention to a different idea which was not included in our original White Paper. The idea is to use a radically different class of materials to produce highly efficient solar cells. We have found that the photovoltaic effect, which as it is well known works with doped band insulators, works in addition, with a class of materials which are called Mott-Insulators. Namely, first, we can show that a p-n junction can be produced by making an interface between a p-doped and an n-doped Mott-insulator. Most importantly, we find that if we appropriately choose these materials to be narrow-band and narrow-gap Mott-insulators they give rise to very high quantum efficiency. We find, theoretically, that a solar photon when it is absorbed by the type of device produces several electron/hole pairs and only very little amount of energy is dissipated by photon emission or other dissipative processes. We are in the process of using Molecular Beam Epitaxy to produce the first such device.

# FLORIDA STATE UNIVERSITY
## *Multi-Generation Capable Solar Thermal Technologies*

**PI:** A. Krothapalli**; Co-PI:** Brenton Greska
**Students:** John Dascomb (Ph.D.), Ifegwu Eziyi (Ph.D.), Jon Pandolfini (Ph.D.), Michael Gnos (M.S.)

**Description:** The objective of the proposed research is to develop and demonstrate small-scale solar thermal technologies that can be used separately, in conjunction with one another, or with existing waste heat producers, thus improving the overall system efficiency.

The development of an indoor solar simulator capable of providing and sustaining 1 kW/m2 over an area of 10 m2

The development of a Rankine cycle-based solar concentrating system that is capable of producing at least 2 kW of electricity adaptation and integration of small-scale absorption-based refrigeration systems that can employ the waste heat from the aforementioned Rankine system.

Integration of existing membrane distillation technology for waste heat recovery from either, or both, of the above-mentioned technologies. Demonstration of a multi-generation system that combines all of the above-mentioned technologies.

**Budget:** $544,226

## Progress Summary

*Task 1: Develop an indoor solar simulator*

Testing of the solar simulator components has begun (Figure 1). The results from two of the test configurations are shown in Figure 2. It can be seen that there is uniform light distribution without the reflector but it is only 40% of the desired intensity. With the reflector the maximum intensity rises to 80% of the desired value but it is concentrated over an unacceptably small area. A number of configurations will be tested in an attempt to address these issues.

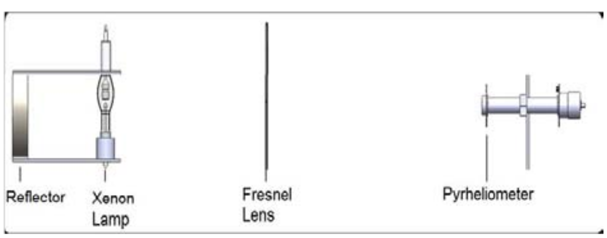


**Figure 1. Experimental setup for solar simulator design development.**

A low-cost pyreheliometer is under development at ESC for use with the simulator and other outdoor activities requiring direct beam radiation (Figure 2). Work on the tracking system for the low-cost unit is currently underway. Cost for pyrheliometer and tracking system ~$500

A first generation solar generator has been built to verify the basic design principles of solar steam generation using dish system. Figure 3 is the system installation picture on the FSU at ESC. The results of this work is described in a recent M.S thesis (John Dascomb, August 2009)

**Figure 2. Pyreheliomoeter**