Energy Storage Systems Laboratory

Laboratory Coordinator: Dr. Jishnu Bhattacharya

List of Major Equipment:

- Blue wave miniature spectrometer (350-1100 nm)
- Two axis solar trackers
- Water salinity meter
- Compact solar simulator
- Thermal chamber for destructive battery testing
- Sonicator for nano-enhanced PCM
- Pyranometer and Pyrheliometer
- Parallel computing cluster

Brief description of the laboratory:

ESSL (Energy Storage Systems laboratory) focuses on various storage technologies including electrochemical and thermal systems. The Li-battery based systems are analyzed in terms of fundamental material characterization and prediction. Moreover, thermal management techniques are experimented on in terms of applications in the electric vehicles. Thermal storages are linked to the solar heat collection and conversion. Solar conversion and utilization experiments are performed in terms of photovoltaic, beam-concentrator, beam-splitting and desalination applications. Performance enhancement techniques in phase change material based thermal storage systems are analyzed for various applications. Thus, ESSL tries to answer few useful questions in the field of energy conversion and storage.

Laboratory research keywords:

Lithium-ion battery; thermal management; solar conversion; thermal storage; desalination; heliostat field; parabolic trough; nano-enhanced PCM;

Major Research and Development Contribution of the Laboratory

Year	Major research and development activity
2020-2021	▪ Formulation of optimal layout for fixed plane solar photovoltaic array ▪ Development of algorithm for shading and blocking loss estimation in a heliostat field ▪ Prototype development of a nano-enhanced membrane-based desalination system
2019-2020	• Design and installation of destructive battery test chamber

	• Experimental evaluation of heat generation by Li-ion cells under pulse discharge condition and testing the validity of Bernardi equation • Estimation of spectral factor as function of angle of incidence
2018-2019	▪ Development of universal non-dimensional number (Runaway Mitigation Number or RMN) for comparing thermal runaway mitigation in large battery packs ▪ Development of layouting algorithm of parabolic trough collector field where inter-trough shading and blocking are included
2017-2018	▪ Development of real-time spectral factor estimation based on local conditions and weather – case study for Kanpur ▪ A novel stationary concentrator is developed for low concentration, low cost photovoltaic system
2016-2017	▪ Development of modular sensible heat storage system and demonstration of its thermodynamic advantage
2015-2016	▪ Building computational facility for large scale parallel computing ▪ Discovery of new ground state structure for vanadium pentoxide through computational structure search

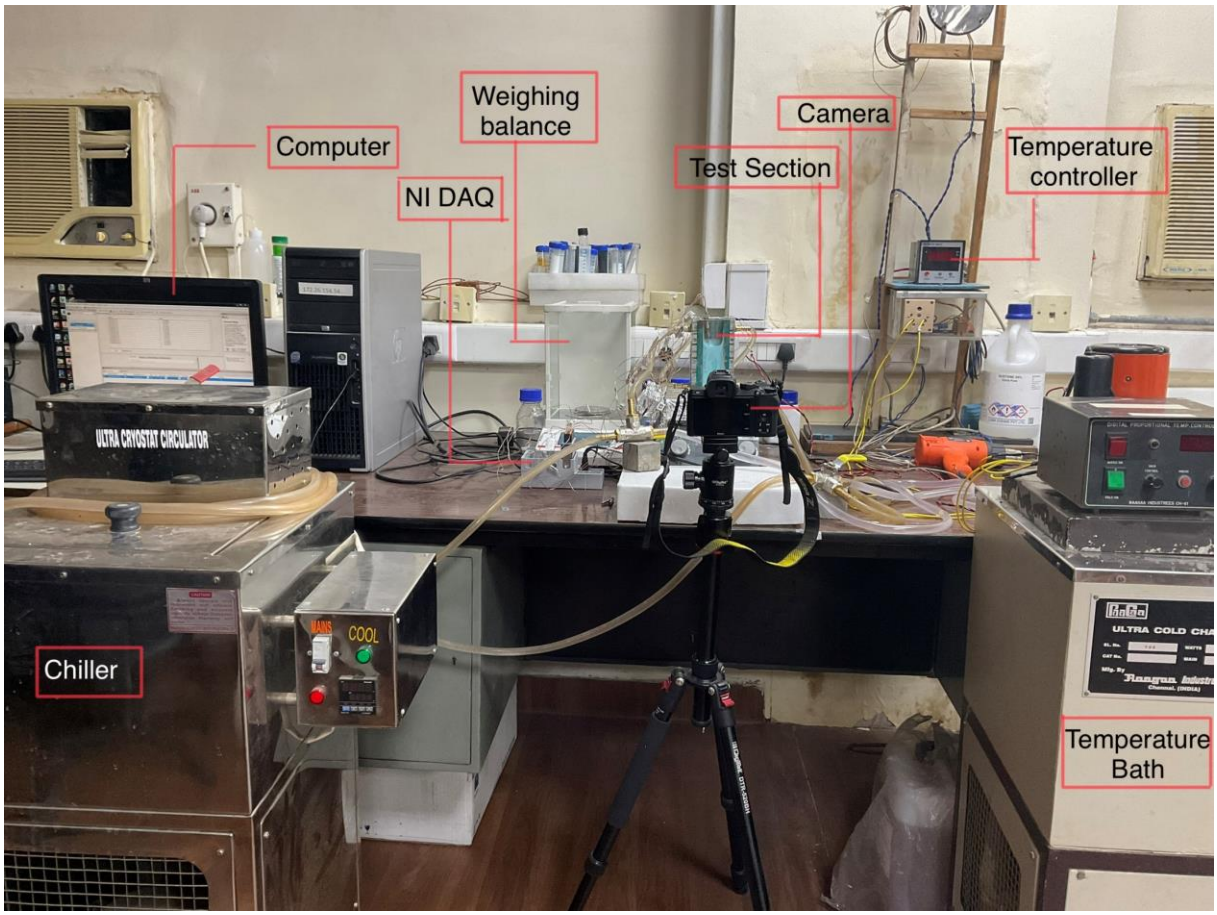

Figure #1: Experimental facility for nano-enhanced PCM based thermal storage systems

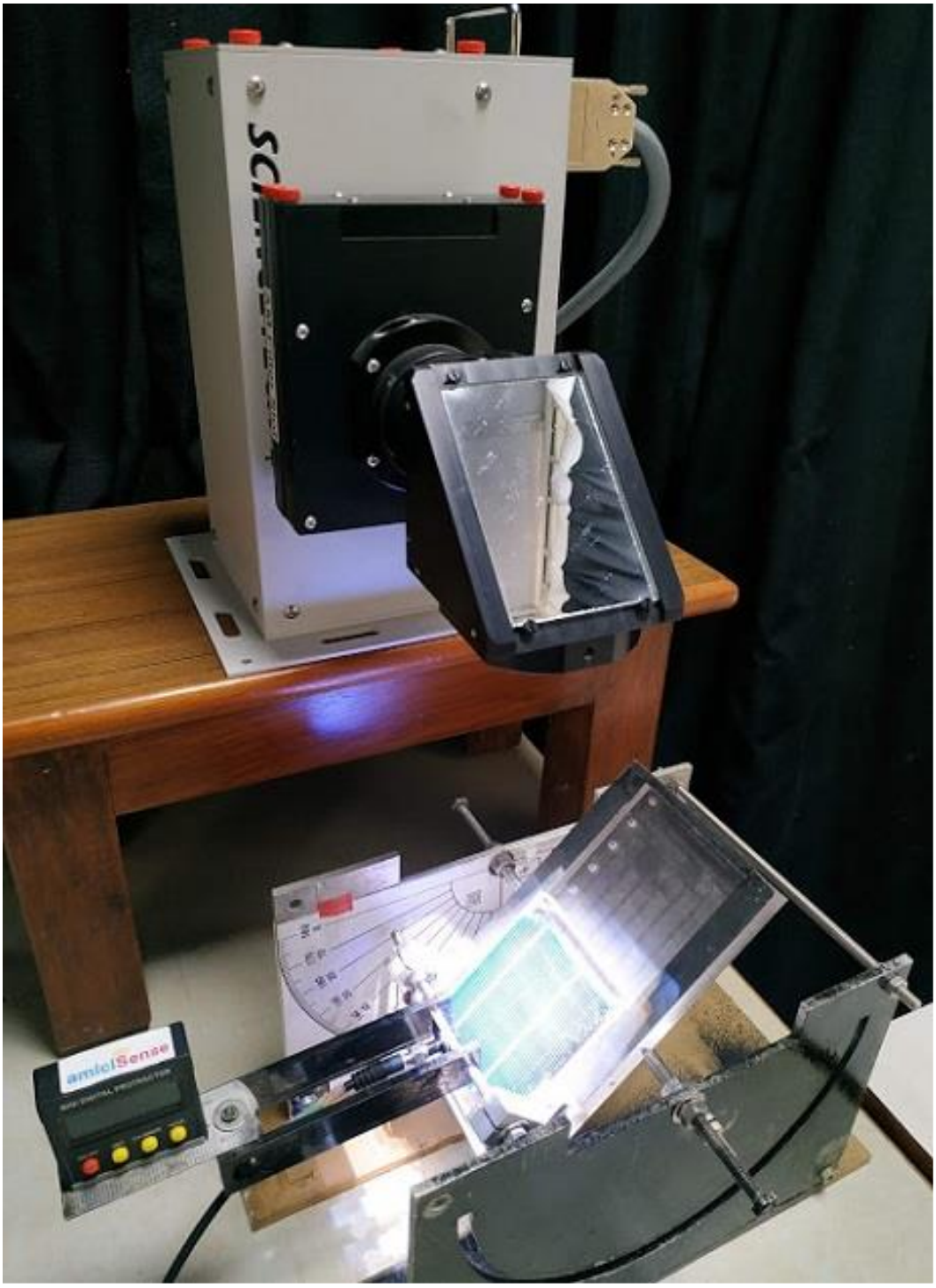

Figure #2: Experimental facility for determining the effect of angle of incidence on solar photovoltaic cells

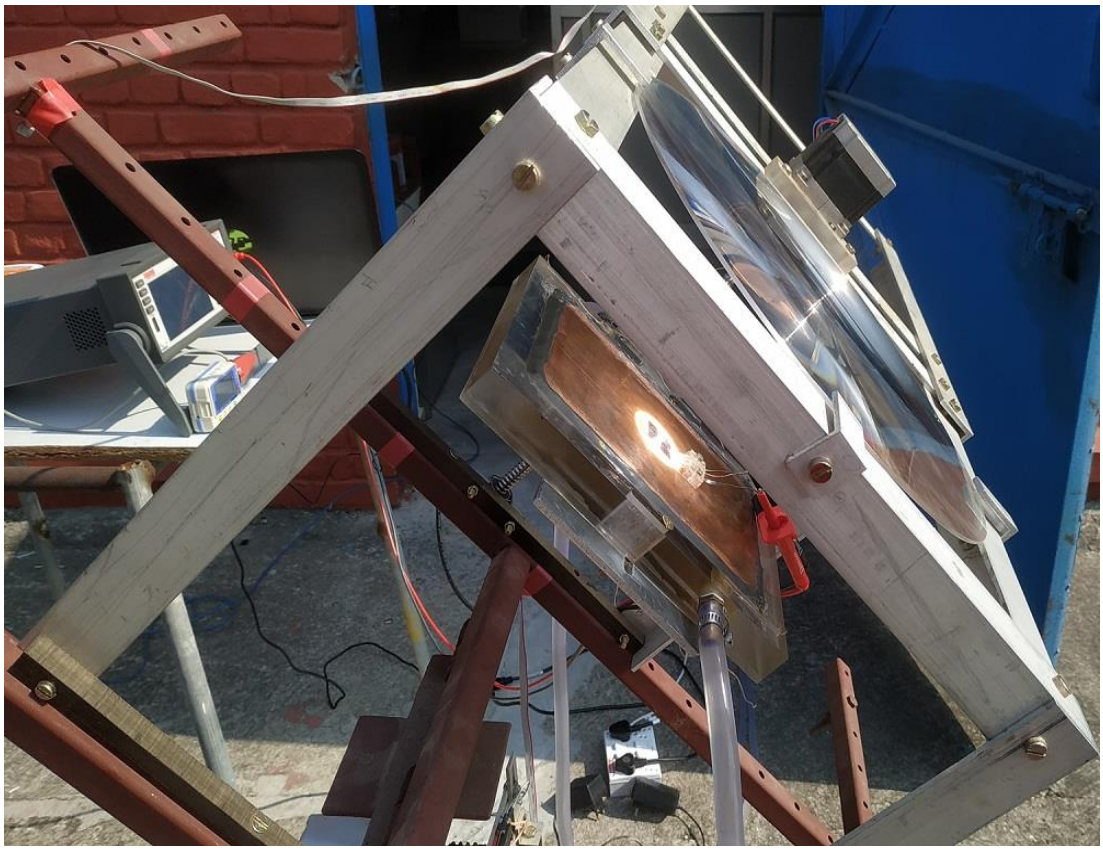

Figure #3: Solar concentrator mounted on two axis solar tracker

Figure #4: Two axis solar tracker for testing large scale panels

Figure #5: Solar desalination system based on Fresnel concentrators and nano-enhanced mebrane