

Helsinki school energy storage

Research on new energy technologies at Otaniemi Campus was originally initiated at the Department of Engineering Physics (Helsinki University of Technology) in 1979. Early work included solar energy and energy storage.

The current research focus is on solar cells and fuel cells (materials and devices), and complex systemic issues with large-scale renewable energy schemes (systems). Specific topics include flexible and wearable nano-solar cells, nano-composites for low-temperature solid oxide fuel cells, energy-flexibility, energy frugality,.

The group is responsible for advanced and renewable energy teaching both on undergraduate, graduate, and postgraduate levels within the PHYS-Programme in Engineering Physics. A specialization package in new energy technologies is provided. The group is also coordinating the Multidisciplinary Energy Sciences M.Sc. minor offered to all Aalto U students.

The group is lead by Professor Peter D. Lund. Key people in the group include University Lecturer (Mr.) Janne Halme (solar cells), Research Fellow (Mrs.) Kati Miettunen (solar cells), Research Coordinator (Mr.) Imran Asghar (fuel cells), Post-Doc (Mrs.) Kerttu Aitola (solar cells). In addition, seven doctoral students (+four at VTT) and several B.Sc. and M.Sc.-level research assistants are enrolled in the group. International visiting researchers are hosted on regular basis. Docents (adjunct) are Dr. Hannele Holttinen (VTT, wind power), Dr. Janne Halme (Aalto U, solar energy), Dr. Kati Miettunen (Aalto U/CHEM, solar cells), Dr. Imran Asghar (Aalto U, nanomaterials for energy).

A dye-sensitized solar cell (DSSC) is a molecular level electrochemical solar cell, where light absorption and current generation occurs in dye molecules attached to a nanostructured TiO₂ electrode. Main advantages are a rather good efficiency with simple manufacturing methods, economic and abundant materials, and lending to high throughput roll-to-roll production. DSSC research requires multidisciplinary research e.g. combining physics, chemistry, materials, and engineering.

The work on DSSCs was initiated in our group in 2001. The research focus is on cell materials and preparation methods, impedance spectroscopy of charge transport in the cells, optical characterization of the cells and identification of factors affecting their long-term stability. Special emphasis is laid on flexible DSSCs, e.g., on plastic or metal sheets (collaboration with industries) and new materials, e.g. cobalt-complexes, perovskites. The efficiency obtained with our metal-based DSSCs is among the best in the world.

Key research topics include:

Contact persons: Dr. Janne Halme, Dr. Kati Miettunen, Dr. Ghufuran Hashmi, Professor Peter Lund ([email#160;protected])

Fuel cells are electrochemical devices that convert the chemical energy of fuel and oxidant directly into electricity and heat. Fuel cells offer high efficiency, low emissions, modularity and quiet operation. Fuel cells are a promising candidate for powering a wide range of applications, from portable electronics to micro-power plants.

Fuel cells research in our group started in the early 1990s on low-temperature PEM fuel cells and hydrogen storage. Presently, we work on nano-composites for low-temperature SOFC fuel cells operating at 400-600°C. The focus is on new nanomaterials to improve performance and lifetime of these cells. Research topics include:

Contact persons: Dr. Imran Asghar, Mr. Sami Jouttijärvi, Professor Peter Lund ()

New energy technologies and systems link closely to global energy issues and future energy solutions as well as to distributed power generation.

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Web: <https://kary.com.pl/contact-us/>

Email: energystorage2000@gmail.com

WhatsApp: 8613816583346

