Stuttgarter Physikalisches Kolloquium

Fachbereich Physik, Universität Stuttgart
Max-Planck-Institut für Festkörperforschung
Max-Planck-Institut für Intelligente Systeme

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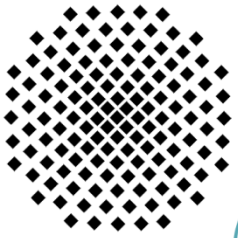

Dienstag, 20. Dezember 2016	17:30 Uhr	Hörsaal V 57.01

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Blue energy, ionic liquids, and heat-to-power conversion with nanomaterials

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Abstract

More than 2 kJ of (free) energy is getting dissipated with every liter of river water that flows into the sea. This energy, which is equivalent to a waterfall of 200 meter, can nowadays be efficiently harvested with devices based on modern nanomaterials such nanoporous electrodes and ion-selective membranes. For instance, a water-immersed supercapacitor composed of nanoporous carbon electrodes (with a km^2/kg surface area) has recently been used to harvest this so-called “blue energy” through a fourfold charging-desalination-discharging-resalination cycle that bears a strong resemblance to the expansion-cooling-compression-heating cycle of a classical Stirling heat engine. We will discuss this analogy and present calculations to show that the harvested blue energy per liter can be *doubled* if the fresh water is warm (50C) rather than cold (10C), where the elevated temperature should stem from waste heat. We will also briefly discuss another recent heat-to-power converter that is based on a supercapacitor filled with an ionic liquid, and a device that converts small mechanical vibrations into electricity using deformable water droplets between a vibrating parallel-plate capacitor. In all these cases ubiquitous gradients and sources are used to sustainably harvest electric energy using a variable capacitance.