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Self-oscillations in Photovoltaic, Thermoelectric and Fuel Cells

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A standard textbook picture of photovoltaic/thermoelectric /fuel cells and biological engines (e.g. proton pump) assumes a direct transformation of light, heat or chemical energy into electric current. However, this scheme is inconsistent with the basic principles of electrodynamics and thermodynamics. To solve this problem the mechanism of collective electric charge self-oscillations fed by a constant energy supply controlled by a feedback mechanism , has been proposed. These coherent oscillations play a role of a piston pumping electrons and holes against the gradient of electrochemical potential. A simple analog system – a steam engine used to propel the so-called “putt-putt boat” – is used to illustrate the physics of work generation in the discussed conversion engines (see [1] and references therein).The basic qualitative prediction of this model are: a) existence of oscillating component in a charge separation dynamics, b) emission of long-wave radiation (THz radiation for semiconductor solar cells) produced by the oscillating component, c) enhancement of photocurrent by resonant external long-wave radiation. The recent experiments with organic photovoltaic materials illuminated by laser pulses exhibit the phenomena a) and c) strongly supporting our theory.

Robert Alicki received his MS in 1974, PhD in 1977 and was a postdoctoral research assistant from 1974-77 at the University of Gdansk. In 1977 he became an Assistant Professor and in 1994 received his full professorship at Gdansk. Research activity is devoted to mathematical physics , nonequilibrium statistical mechanics, quantum open systems, quantum dynamical systems, quantum thermodynamics, quantum information and foundations of quantum mechanics

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