

Use of Parametric Mechanisms for Energy Conversion

Herbert Wetzel*

Parametric mechanisms are already intensively used in optics and electronics, e.g. for generation of second harmonics or for parametric amplifiers. A common feature of all these processes is the periodic variation of an energy-defining parameter (it is not possible to use the variation of damping elements). In order to discuss the principle mechanism of introducing energy into an oscillating system upon illumination, we consider an oscillating electric circuit. It can be conventionally excited by an external force so that the system can then be described by an inhomogeneous differential equation, but it neither affects the capacitance nor the inductance. Thus, the energy-defining parameters of the system remain unchanged. However, it can be shown that it is also possible to excite the circuit upon periodic variation of one of these parameters if the frequency of the variation is twice the characteristic frequency. We proposed the use of a photosensitive dielectric to pump oscillating circuits by sunlight. The microscopic process

in this case is the change of dipole moments upon illumination. If the dipole moment of the excited state is larger than that of the ground state the transition would do work on the electric field existing between the condenser plates. Thus, energy is added to the system. If the resonance frequency is adapted to the lifetime of the excited state, recombination takes place at lower field strengths (in the ideal case at zero field strength when the energy of the circuit is purely electromagnetic) which draws less energy out of the circuit than was introduced. In order to compensate for the losses, the capacitance variation has to be

$$\frac{\delta C}{C} = 2R \sqrt{\frac{C}{L}}$$

For small losses ($R < 100 \Omega$) a variation of about 5% would be sufficient.

As outlined above, each system, which is able to oscillate, can be excited by periodic variation of one of its energy-defining parameters. Such a type of excitation is much more efficient than excitation by an external force.

Hence, it follows that the proposed «micro-pumps» which work by use of «mechanically photoactive» polymers (see pre-



Herbert Wetzel: Born 1959 in Tübingen, Federal Republic of Germany. Ph.D. in physics (Contribution to the Surface Enhanced Raman Scattering) 1981 from the Fritz-Haber-Institut der Max-Planck-Gesellschaft in Berlin, group of Prof. H. Gerischer. In 1981 he joined the group of Prof. H. Tributsch at the Hahn-Meitner-Institut in Berlin, in order to work on Solar Energy Conversion.

ceding section) should rather be excited by parametric mechanisms than in the conventional way. This means the polymers should be introduced into the system as length-controllers at a point where length is an energy-defining parameter. To give a simple example:

- variation of the length of a pendulum may lead to parametric excitation;
- moving of the suspension would only cause external excitation.

References:

- H. Wetzel, H. Tributsch, *Sol. Energy* 37 (1986) 1.
 R. W. Glazebrook, A. Thomas, *J. Chem. Soc. Faraday Trans. 2*, 78 (1982) 2053.

* For correspondence address, see List of Participants, p. 242.