Responsive Elastic Medium as a Source of Negative Feedback for Building Chemomechanical Oscillators

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In oscillatory chemical reactions the (+) and (–) feedbacks in the mechanism are both of chemical nature. The concept of *synergetic chemomechanical oscillators* was worked out in Bordeaux in the early 2000's predicting that the coupling between a *(+) feedback of chemical nature*, *i.e.* an autocatalytic chemical reaction, and a *(–) feedback of physical nature*, *i.e.* the shrinking of a chemoresponsive gel in response to one of the products of the autocatalytic reaction, can induce spontaneous periodic size changes and chemical oscillations in the gel if this latter is *diffusively* fed from a steady low extent of reaction environment. Under these conditions *swelling can switch on* the autocatalytic reaction in the gel, while *shrinking can turn it off*. No oscillatory chemical reaction is needed, but no oscillations develop without large enough size-changes. Although the synergetic chemomechanical concept is clear and general, the strategy how to find experimentally the right conditions for a new chemical reaction is being explored in our ongoing research. The previously constructed oscillators based on acid auto-activated reactions (chlorite-tetrathionate (CT) [1], bromate-sulfite (BS) [2], and iodate-sulfite (IS) [3]) have in common that a reasonable increase in the acidity occurs per cycle in the gel (to pH 4 – pH 2). In our new synergetic oscillator with the hydrogen peroxide-sulfite (HPS) reaction we solved the challenge to drive the system with variations of two orders of magnitude less, between pH 7 and 6. As the steps to follow become more and more clearly defined, more and more delicate (*e.g.,* enzymatic) or less studied (*e.g.,* hydroxide ion or metal ion generating) reactions could be exploited.

1. V. Labrot, P. De Kepper, J. Boissonade, I. Szalai and F. Gauffre, *J. Phys. Chem. B* **109**, 21476–21480 (2005).

2. J. Horváth, I. Szalai, J. Boissonade and P. De Kepper, *Soft Matter*, **7**, 8462–8472 (2011).

3. J. Horváth, "*Sustained Large Amplitude Chemomechanical Oscillations Induced by the Landolt Clock Reaction"* (to be submitted).