Complex cooperative behaviour of globally coupled bistable electrochemical micro-objects

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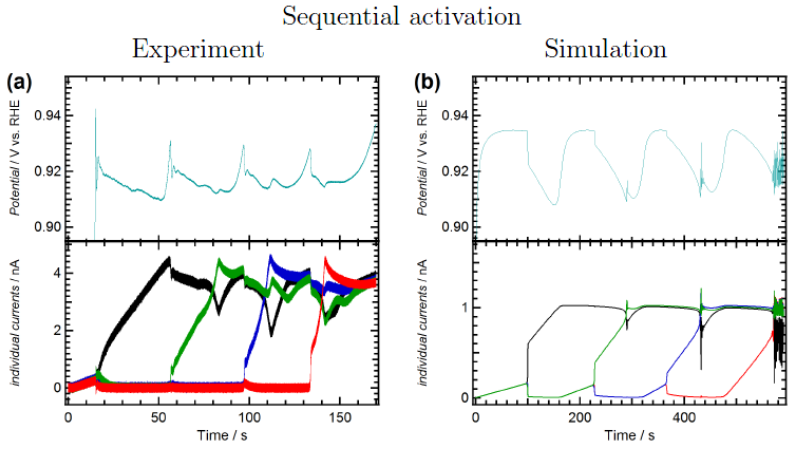
Bistable kinetics is a key process for the design of new multifunctional materials. In such systems, the nature and strength of the coupling between the individual bistable elements may lead to the emergence of cooperativity. We have investigated the influence of global coupling on the cooperative behavior of bistable electrochemical micro-objects. For this purpose we used a model reaction, the electrooxidation of CO on an array of individually addressable platinum microelectrodes. The global coupling arises from the operation of the reaction under constant current conditions since the galvanostat varies the potential of all the microelectrodes simultaneously in response to a change of the current of one microelectrode. A home made galvanostat allows the individual currents flowing through each of the microelectrodes to be measured. Three different kinds of cooperative behaviour could be evidenced for the first time and explained with the help of mathematical modelling. When the applied reaction current value is linearly increased, sequential activation of the microelectrodes was observed (cf. Fig. 1), while a complex dynamical switching regime was obtained when the current was kept constant. At higher pH values, spontaneous oscillations of the current through individual electrodes emerged.



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