Synchronization of electrochemical bursters: The role of bifurcation sequences

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The behavior of the Fe/H_2SO_4 electrochemical oscillator is transformed from tonic (periodic) to bursting when a small amount of chloride ions (of the order of mM) is present in the electrolytic medium. The type of bursting is determined by: (a) the bifurcation of the rest state to repetitive firing and (b) the bifurcation of the repetitive firing back to the rest state. By considering the applied potential V as a bifurcation parameter of the system, it is shown experimentally that for low values of V the electrochemical burster is of elliptic (subHopf/fold cycle) type whereas for high values of V is of square-wave (fold/big homoclinic) type. The response of coupled electrochemical busters is determined by the type of bursting. Thus, in-phase burst synchronization takes place for elliptic bursters, no matter if the connection is excitatory or inhibitory. Spike synchronization is also observed for the case of elliptic bursters which is in-phase for excitatory coupling and out-of-phase for inhibitory coupling. For square-wave bursters neither burst or spike synchrony is observed for any connection type. It is claimed that the response of assemblies of electrochemical bursters is determined mainly by the non-linear dynamic characteristics of the electrochemical interface.