Probing the oscillating Belousov-Zhabotinskii reaction with micrometer-sized electrodes: the effect of C, Pt, and Au

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The Belousov-Zhabotinskii (BZ) oscillating reaction mixture (malonic acid, bromate, and cerium ions in a strongly acidic medium) was studied. The oxidation state of the $\text{Ce}^{+4}/\text{Ce}^{+3}$ catalyst fluctuates and drives the open-circuit potential (OCP) of the solution. Oscillatory profiles were analyzed using Au, Pt and C micro- and macro-electrodes to study the stages of induction, oscillating, and equilibrium. The oscillating behavior of the BZ system is transient, reaching a non-oscillating reductive steady-state. The time for achieving the oscillating state depends on the substrate (electrode material and size) while the number of oscillations is independent of substrate. Fast Fourier transform (FFT) analysis yields the fundamental frequency of the oscillating profile and evaluates the exponential falloff as the system approaches equilibrium. Also, Ce^{+4} concentration was tracked in the UV Vis. Chemical oscillations of the catalyst Ce^{+4} ion were reproduced using a numerical model, and its dynamical profile was analogous to the experimental data.

Keywords: BZ reaction; dissipative structure; oscillating reaction; ultra micro-electrodes

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