Chemical Waves and Chemical Oscillations

This interactive tool is helpful to observe the phenomena of Chemical Waves and Chemical Oscillations by using the Belousov-Zhabotinsky reaction (for more information about this reaction, please read the book “Untangling Complex Systems: A Grand Challenge for Science” by P.L. Gentili). Go to the wet laboratory, wear a white coat, gloves and safety glasses, and prepare the following solutions using deionized water as the solvent (see Figure 1):

- Solution A: $KBrO_3$ 0.6 M in H_2SO_4 0.6 M.
- Solution B: $CH_2(COOH)_2$ 0.48 M
- Solution C: KBr 0.97 M
- Solution D: Ferroin (tris(1,10-phenanthroline) iron(III) sulphate) 0.025 M.

Figure 1. The glasses and the other tools required to perform this experiment.

Into a small Erlenmeyer flask, introduce 7 mL of solution A, 3.5 mL of solution B, and 1 mL of solution C. Close the container with a stopper and stir the solution with a magnetic stirrer. Bromate oxidizes bromide to bromine, and the solution looks brown (see Figure 2). The brown color slowly disappears because bromine reacts with malonic acid to form bromomalonic acid.

Figure 2. The preliminary steps for the BZ reaction, when bromine is formed and then consumed.

When the solution becomes transparent, add 0.5 mL of D and stir. Use a pipet to transfer 2.5 mL of the mixture into a cuvette having a tiny stir bar and pour the rest into a Petri dish (about 10 cm in diameter) to cover its surface uniformly. Place the cuvette in a UV-Visible spectrophotometer and maintain its solution under stirring. It is possible to record the spectrophotometric oscillations and determine the period of the chemical oscillations (see Figure 3).

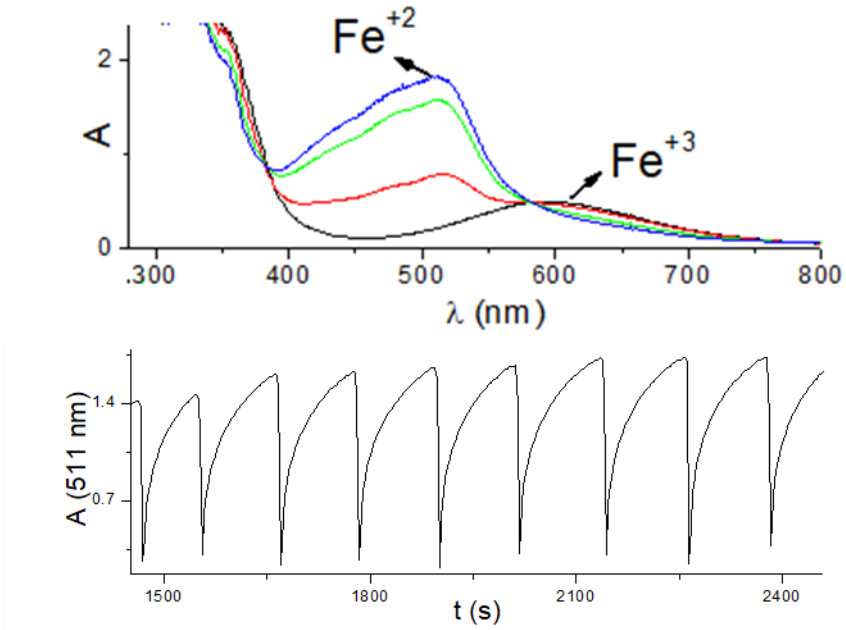

Figure 3. UV-visible absorption spectra for the BZ reaction (on top) and time evolution of the absorbance at 511 nm (at the bottom).

Place the Petri dish on a sheet of millimeter graph paper and leave it quiescent for a while. Then, chemical waves will appear, as shown in Figure 4.

Figure 4. Chemical waves generated by the BZ reaction.