CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
S0511

Project Title
Kinetics of the Zinc-Copper Voltaic Cell

Abstract

Objectives/Goals
This study was on the kinetics of the zinc-copper voltaic cell. The goal was to determine the order of the reaction with respect to Cu2+ concentration, which was ultimately done by exploiting the direct proportionality of the cell current to the rate of reaction.

Methods/Materials
There will be one concentration of KNO3 solution, but the CuSO4 and ZnSO4 concentrations will vary. Place the necessary amount of ZnSO4∙7H2O in a 1 L volumetric flask filled partially with distilled water. Swirl the flask gently to dissolve as much of the solid as possible. Pour the ZnSO4 solution into a beaker and the CuSO4 solution into another beaker. Secure the U-shaped drying tube with a clamp. Pour the KNO3 solution into the tube until the level in each arm reaches the lip. Plug the ends of the arms with cotton balls, unclamp the tube, and carefully invert the tube over the beakers containing the ZnSO4 and CuSO4 solutions, placing one arm in each beaker. Cut the zinc and copper strips to the same length and mark a line on both strips about 1 cm from the top. Place the marked zinc strip in a clamp and tighten the wing nut until the strip is secure. Immerse it in the ZnSO4 solution by lowering the clamp until the solution reaches the penciled line on the strip. Repeat the procedure in step 4 with the copper strip and the clamp on the ring stand next to the beaker containing the CuSO4 solution. Connect the grabber end of a black multimeter lead to the zinc electrode and the grabber end of a red multimeter lead to the copper electrode.

Results
The plots of cell current versus time reveal that the current, and thus the rate of reaction, increased during certain time intervals. The equations for chemical kinetics I am using do not allow such a possibility, so I concluded that this effect is likely due to variations in temperature or system conductivity. As such, I selected portions of the cell current data, eight total, which appeared to be free of these effects and used them to obtain time series of [Cu2+].

Conclusions/Discussion
The greatest limitations on this experiment, if not the only, were systematic effects from various sources. The predicted culprits are temperature variation, variation in system conductivity (solution and/or electrodes), induced currents from the magnetic stirrer, effects of stirring at regular intervals with a glass rod, and interference from cellular telephone towers.

Summary Statement
The primary goal was to determine the order of the reaction with respect to Cu2+ concentration, which was ultimately done by exploiting the direct proportionality of the cell current to the rate of reaction.

Help Received
Used lab equipment at Ribet Academy