

Name _____ Date _____ Class _____

Part 1: Platinum-Catalyzed Propulsion of Foam Boats Student Worksheet

Introduction

As scientists develop more complex and advanced nano devices, a variety of propulsion systems have been proposed for providing a means of moving these devices for the purpose of accomplishing exciting feats. Scientists have envisioned such innovations as nano-trolleys that deliver drugs to cancer cells as well as nano-scrapels that perform delicate surgery without the need for creating an incision in the skin. In this activity, we will explore one of these proposed propulsion designs and will explore some factors that affect the performance of the system.

Purpose

1. To build a vessel powered by hydrogen peroxide catalyzed by platinum.
2. To observe the motion and processes involved in a macro-scale platinum catalytic engine.

Question(s)

1. In what way(s) can a catalytic reaction provide a means of propulsion?
2. How might a catalytic propulsion system work differently on the nanoscale as compared to the macroscale?

Hypothesis Develop a hypothesis to answer one or both of the questions listed above.

Key Terms

Brownian Motion: _____

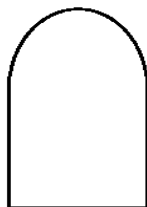
Catalysis: _____

Materials per class (of 6-8 student groups)

- Foam poster board
- One fine painting brush (per student group)
- One Hobby Knife (per student group)
- One 6''x 6''x 2''deep Tupperware or comparable basin (per student group)
- One Small Glass vial (8-25 mL)
- One micropipettes (per student group)
- Platinum Ribbon/Foil or *Platinum (50%) on Carbon* and *Nafion resin*
- Hydrogen Peroxide (6%) (*Note: 3% household type produces insufficient propulsion*)

Procedure

1. Preparing the Platinum-Peroxide Boat
Assembling the Boats
 - a) Cut the boat shape shown below out of foam poster board.



2. Apply the platinum layer to the back of the boat. Use a fine-tipped artists' brush to carefully spread a layer of platinum across the entire back side of the boat. Allow to dry for at least 2 hours.

B. Testing the Boats

- 1) Use a micropipette or beakers to dispense the 6% hydrogen peroxide solution in a shallow (< 1 cm) layer in a 6''x 6''x 2''deep Tupperware or comparable basin.
- 2) Gently place the boat on the air-water interface of the solution. Initially, push the back side of the boat downward so that the platinum surface becomes entirely submerged in the solution. Observe and record evidence that the catalytic reaction is taking place.

- 3) Observe and describe the motion that is produced as a result of the reaction. If possible, measure and record the speed of the boat as it moves through the peroxide solution.

- 4) Experiment with different concentrations of peroxide to determine any affect on boat speed or the production of bubbles. Describe any effects of concentration on the motion of the boat.

- 5) Review the article and video found at the links below. Summarize how hydrogen peroxide and platinum propulsion functions differently on the nanoscale.

www.SciAm.com/nanomotor

<http://www.scientificamerican.com/article.cfm?id=how-to-build-nanotech-motors>
