Slowing the Glow

The rates of reactions of lightsticks are altered by changing their temperatures.

Application

Kinetics • Reaction Rates

Theory

The reaction is a chemiluminescence reaction, and like most reactions, its rate is temperature dependent. The lightstick contains dilute hydrogen peroxide in a phthalic ester solvent which is held in a thin glass ampule. This ampule is surrounded by a solution containing phenyl oxalate and a fluorescent dye. [9,10-bis(phenylethynyl) anthracene or 9,10-diphenyl anthracene.] When the ampule is broken, the peroxide and the phenyl oxalate ester react. During the course of the reaction, an intermediate is produced which transfers energy to the dye molecule. Visible light is emitted when the excited dye returns to the ground state.

Materials

Beakers, 400-mL, 2

Ice

Hot plate or Bunsen burner

Commercial lightsticks, 2

Safety Precautions

Be careful not to puncture the outer plastic tube of the lightstick. According to the manufacturer, the materials in the lightsticks are relatively non-hazardous, but common sense dictates that the solutions be kept contained. Wear chemical splash goggles and always follow laboratory safety rules while performing demonstrations.

Demonstration

Fill one of the beakers with hot water, and the other with ice water. Place a lightstick in each beaker, and allow about 3 minutes for temperature equilibration. Following the directions for the lightstick, break the inner ampule of each. The one that was in the hot water will be significantly brighter than the one that was in the ice water.

Note: Lightsticks do have a shelf life. Older materials do not work as well. It seems that they start to lose power after about a year, and after about four years, they will not react at all. Use fresh lightsticks!

Disposal

Used lightsticks may be discarded in the trash.

Reference

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