

Superheated Steam by William C. Deese

Description: A demonstration showing the charring of paper and the ignition of a match by superheated steam (water vapor above 100C).

Materials: ring stand, ring, padded wire screen, clamp
250 mL Erlenmeyer flask, rubber stopper with one hole
two Bunsen burners, coiled copper tubing, tongs, matches

Procedure:

- 1) Put on your safety goggles.
- 2) Set up the ring stand with clamp, ring, and wire screen as shown below.
- 3) Fill the flask half full of water or three-fourths full of ice.
- 4) Attach the stopper with coil to flask.
- 5) Attach both Bunsen burners to the gas line.
- 6) Attach the flask with the clamp on the ring stand.
- 7) Light and adjust the Bunsen burner under the flask.
- 8) When water begins to boil, show the effect of the steam plume on a strip of paper.
- 9) Hold the second burner by the base and heat the copper coil. **(Caution!)** As the steam plume increases in temperature, it will become invisible.
- 10) Using tongs, hold a strip of paper in the superheated steam until it chars. A kitchen match can be lit too.

Discussion: $\text{H}_2\text{O}(\text{l}) + \text{heat} \rightarrow \text{H}_2\text{O}(\text{g})$ The visible steam plume contains water vapor and tiny droplets of liquid water that formed as the steam cooled in the copper tubing. Heating the tubing causes the droplets to evaporate. At this elevated temperature, only the invisible superheated steam exits the tube.

Hazards: Use **EXTREME Caution!** Superheated steam can cause serious burns! Always clamp the flask to the ring stand. Be sure to let the equipment cool before disassembling.

Reference: Shakhshiri, Bassam, *Chemical Demonstrations; A Handbook for Teachers of Chemistry, Volume I*, p. 93, University of Wisconsin Press, 1983.

