

Combustion of Magnesium in Dry Ice

The best part of waking up is the screeching of hot metal on solid CO₂. In your cup.

Chemicals and Equipment Needed

- 2-10 lb blocks dry ice
 - You must place the order by noon the day before you need it
 - I always order 3, just in case
- Mg powder – **F3**
- Mg turnings – **F3**
- Mg ribbon – **F3**
- Cooler – **A5**
- 4 Ceramic mats – **U4**
- 4 Cloth towels – **U4**
- Cold gloves – **U4**
- 4 deflagrating spoons – **U2**
- Bunsen burner – **T**
 - For preparation
- Matches or striker – **U1**
- Propane torch – **A4**
 - For presentation
- Weighboats – **A3**
- Tongs or forceps – **A2**

Hazards

- Dry ice is very cold, -79°C/-110°F. Do not handle dry ice with your bare hands
- Dry ice sublimates (goes from solid straight to gas), and carbon dioxide gas is colorless, odorless, and heavier than air. CO₂ can displace air along the floor, so be very careful if there are children present.
- After the demo, place blocks in the hood or a similar well-ventilated area to sublime.
- The demo itself produces sparks, so a flame retardant lab coat must be worn.

Preparation - Blocks

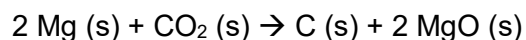
- Best done with two people
- First examine the blocks. Always order three in case one is broken. If one is smaller or is missing a corner but is otherwise intact, use that as the top block.
- Set the Bunsen burner in the hood and light it. Nest the deflagrating spoons inside one another and have one person start heating the bowl ends of the nested spoons. The handle will not get too hot.
- The other person should lay the ceramic mats out on a cart and cover them with a towel. Set one of the dry ice blocks on top of the towel. When the spoon bowls are literally red hot, use them to make a depression in the center of the block. The other person should start heating their spoons as soon as the first person is finished. Take turns expanding the depression as needed, until the crater is 3-4 cm across and 2-3 cm deep. It may take as many as 5 reheatings, and be aware that hot metal + dry ice = horrible squeaky/scratchy sound.
 - When the hole looks deep enough, you can take the rubber mallet and a blade screwdriver to widen the hole, then use the heated spoons to clean up the depression.
 - Repeat for the other block.
- Put the blocks back in the cooler, with a towel on the bottom, one in between the blocks, and one on top
 - Ensures they stay cold and don't stick together.
 - Make sure to put the "bottom" block on the top.

Preparation - Demo

- Measure out ~2 g Mg powder and mix with ~2 g Mg turnings in a weighboat
- For each fuse, cut 2 pieces of Mg ribbon about 4" long. Holding the pieces together, wrap them around a glass rod to make a curly fuse. Flare out the bottom in either direction to make a T shape.
 - Provide 2 fuses for the instructor. There may already be some made on **F3**
- On delivery, lay out the ceramic mats in a square and spread one towel on top.

Presentation

- Offer to come out and help the instructor if they have not performed this demo before. If they don't want/need help, make sure they feel comfortable with this demo, and that they have a volunteer to help. Do not remove the blocks from the cooler. They should stay in there until the instructor is ready.
- Pull out a block of dry ice and lay it on top of the towel, hole side up. Pour the magnesium mixture into the hole, and stick the Mg fuse in the center.
- Have a volunteer hold the top block with a towel or with cold gloves. Light the propane torch and use it to light the Mg fuse. Once the fuse is lit, have the volunteer place the other block of dry ice, hole side down, on top of the flaming magnesium. Step back quickly. The reaction produces a bright white light (the Mg burning) and smoke (the CO₂ subliming), dimming to an orange glow (burning carbon)
- Turn on the in-bench hood.
- After a minute or so, the reaction should be complete. Remove the top block of dry ice and examine the results: a black ball of pure carbon, coated with MgO, a white powder. Use the tongs to pick up the ball to display to the class.
 - Turn on the in-bench hood to help clear up the smoke.
- Chemical Reaction



Clean-Up

- Reusable a few times, but you may have to use the top block as the new bottom block.
- Let the dry ice sublime in the hood, and discard the carbon ball in the trash.