The Chemical Safety Mechanism
University of Wisconsin-Madison
Office of Chemical Safety

Lessons Learned: A Titanium Metal Fire

A recent incident in a campus laboratory has focused attention on a number of issues relevant to other labs here. Titanium metal in the form of a powder ignited as the researcher was using a spatula to remove 2 grams of the material from a 50 gram bag. The fire started in the original packaging causing the researcher to drop the package onto the surface of the fume hood. The researcher, in an effort to extinguish the fire, doused the flames with water which caused a reaction which released hydrogen gas and intensified the fire. The researcher then grabbed an ABC-rated fire extinguisher, and (due to the small volume of metal burning) was able to smother the fire without a hydrogen gas explosion.

While large titanium metal pieces are difficult to ignite under normal circumstances titanium metal powders and shavings, like a number of metals, are more easily ignited and therefore pose a fire risk. In this instance the titanium powder was in the form of nano-particles (30-50 nm in size) – the large surface area of this material significantly increasing the risk. The fire most likely started from either a static charge or chemical contamination of the spatula.

Fume Hood after Fire

Positive Actions

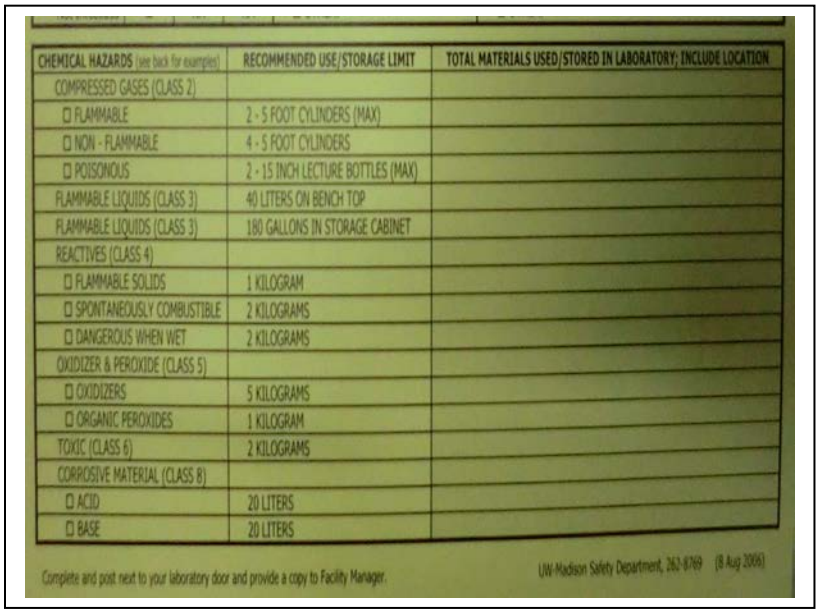
Upon reviewing the incident, a number of key points were noted. These key points and the lessons learned provide valuable information to the rest of the campus. First, there were a number of positive actions taken.

- The researcher involved was wearing personal protective equipment;
- 911 was promptly called and the Madison Fire Department responded within minutes;

Incident Concerns

The review of the incident also uncovered a few concerns which contributed to the incident.

- The researcher was not trained on using a fire extinguisher or what type of fire extinguisher was compatible with different flammable materials in the laboratory. The Material Safety Data Sheet (MSDS) for the titanium powder stated that the material was highly flammable and that a special fire extinguisher for metals should be used in the event of a fire. A Class D fire extinguisher (recommended for metal fires) was not found in the lab. The researcher's initial attempt to put out the fire with water only intensified the reaction.
- The first responders had difficulty assessing the situation properly when they arrived because the Laboratory Emergency Information door card was not up to date. It did not include a list of the hazardous chemicals present. The first responders also did not have access to the MSDS for the material that was burning to help assess the proper course of action.



CHEMICAL HAZARDS (see back for examples)	RECOMMENDED USE/STORAGE LIMIT	TOTAL MATERIALS USED/STORED IN LABORATORY; INCLUDE LOCATION
COMPRESSED GASES (CLASS 2)		
☐ FLAMMABLE	2 - 5 FOOT CYLINDERS (MAX)	
☐ NON - FLAMMABLE	4 - 5 FOOT CYLINDERS	
☐ POISONOUS	2 - 15 INCH LECTURE BOTTLES (MAX)	
FLAMMABLE LIQUIDS (CLASS 3)	40 LITERS ON BENCH TOP	
FLAMMABLE LIQUIDS (CLASS 3)	180 GALLONS IN STORAGE CABINET	
REACTIVES (CLASS 4)		
☐ FLAMMABLE SOLIDS	1 KILOGRAM	
☐ SPONTANEOUSLY COMBUSTIBLE	2 KILOGRAMS	
☐ DANGEROUS WHEN WET	2 KILOGRAMS	
OXIDIZER & PEROXIDE (CLASS 5)		
☐ OXIDIZERS	5 KILOGRAMS	
☐ ORGANIC PEROXIDES	1 KILOGRAM	
TOXIC (CLASS 6)	2 KILOGRAMS	
CORROSIVE MATERIAL (CLASS 8)		
☐ ACID	20 LITERS	
☐ BASE	20 LITERS	

Complete and post next to your laboratory door and provide a copy to Facility Manager. UW-Madison Safety Department, 262-8769 (8 Aug 2006)

On Left: Emergency Door Card outside lab
On Right: Class D fire extinguisher

- The Laboratory did not have a Chemical Hygiene Plan in place to address all safety situations.
- While the Principal Investigator had Standard Operating Procedures (SOP's) in place these did not cover the operations in this particular lab.
- The fume hood had excessive amounts of flammable materials, which had the potential to intensify a fire.
- The baffles on the fume hood were partially blocked with empty plastic begs limiting the respiratory protections that the hood provides.

Flammable Materials Stored in Fume Hood

Lessons Learned

From this incident a number of lessons can be learned which are broadly applicable to the campus:

- *Clear hood of additional flammable materials:* Do not store unnecessary and flammable chemicals in the fume hood. Dispose of all unused and no longer useable chemicals as they increase clutter and risk. Metal fires burn hotter than most flammable liquids so some materials which typically do not burn can ignite.
- *Training:* All laboratory personal need to have documented training on their Chemical Hygiene Plan (CHP) and Standard Operating Procedures.
- *Documents:* All first responder information must be present and up to date (emergency door card needs to be filled out and up to date, and all MSDS must be available to first responders)
- *Fire Extinguishers:* The proper fire extinguisher must be available for all types of chemicals being used. Contact the EH&S Fire Safety Group if you have any questions on fire extinguishers. Group training on fire extinguisher training is available upon request.
- *Storage and use:* Store and use reactive metals separate from flammables.
- *Contamination:* Ensure all equipment is free of contamination before inserting into reactive chemicals.
- *Static charges:* Insure all laboratory equipment is grounded properly and tools are made of non-ferrous/non-conductive materials (i.e. brass, plastic) when working with flammables.

January 2012

For More Information Contact:

Environment, Health and Safety Department
30 East Campus Mall, Madison, WI 53715-1227
Phone (608) 265-5000 · **Fax** (608) 262-6767;
The Chemical Safety Office