

# Risk Assessment Form

(This is an active document and must be maintained)



UNIVERSITY OF  
CAMBRIDGE

## Materials Science and Metallurgy

Date: September 2018

Building: MSM

Supervisor of Room/Area: Judith Driscoll

Room or area: -1.021, -1.022 -1.023, PLD and prep rooms  
(Describe location)

Name of Assessor(s):

### Title of Activity / Experiment / Work Area:

Pulsed laser deposition of thin films using Mk-10 chamber with 201 KrF excimer laser

### Description of Activity / Experiment / Work Area:

- 1) Cleaning substrates  
Substrates are cleaned by sonicating in deionized water, acetone and isopropyl-alcohol, and sprayed with an isopropyl-alcohol and N<sub>2</sub> spray until dry.
- 2) Attaching substrate to heater stage  
Substrates are attached to the heater stage by applying a small (<0.1 ml) amount of silver paste
- 3) Loading heater stage and target flange into vacuum system  
The heater stage is secured to the side of the chamber by 4 bolts and can be removed without a step stool. The target flange is lifted from the top of the chamber and a step stool is required.
- 4) Pumping vacuum systems  
The chamber is pumped down to ~1e-4 Pa using a rotary and turbo pump system.
- 5) Heating substrates  
Substrates are heated up to 750°C for multiple hours inside chamber (heating current <4 A) using a Neocera resistive substrate heater.
- 6) Use of ultraviolet class 4 pulsed laser source (201) to ablate various materials within a vacuum chamber for preparation of thin film samples.
- 7) Annealing substrate in oxygen atmosphere at high temperature
- 8) Removing samples from heater stage
- 9) Cleaning heater stage with isopropyl-alcohol and grit paper

**SECTION 1:** Identify all significant hazards, who or what may be affected by each individual hazard and controls in place to reduce risk to a minimum.

Hazard Description	Hazard to whom or what	Controls in place to reduce risk to a minimum
1a. Inhalation of solvent vapor	Users, others in room	Cleaning takes place within fume hood
1b. Solvent contact with skin/eyes/mouth	Users	Use nitrile gloves, clean in fume hood
2a. Inhalation of vapors	Users, others in room	Use fume hood
2b. Silver paste skin/eyes/mouth contact	Users	Use nitrile gloves and fume hood
3a. Loading/unloading involves heavy lifting, standing on a small step stool for target flange. Can injure back or fall.	Users, others nearby in case of fall	Training in correct loading technique and posture.

4a. Asphyxiation	Everyone in room	Pumps and room contain gas extraction system. Oxygen sensors in room.
5a. High temperature of heater	Users	Heater is fully enclosed within chamber whenever it is hot.
5b. Electric shock from applied current	Users, others in room	Applied current <0.4 A. Operational protocol, wires are not exposed, do not adjust cables whilst current is on.
5c. Chambers are hot during substrate heating	Users, others in room	Training procedures for users in room. Metal frame around base of chamber. Chambers are not sufficiently hot to cause injury with a short touch.
6a. High voltage inside laser chassis	Operators	High voltage components only opened by qualified service engineer.
6b. KrF gas inside chassis	All in room	Flourine gas detection system installed. Use of pre-mixed gases with low F <sub>2</sub> concentration.
6c. Unauthorized operation	All in room	Room access restricted by locks to hallway
6d. Beam delivery (normal operations): Class 3B laser hazard to eyes and skin inside beam delivery path.	All in room	Beam path fully enclosed, interlock system in place. All room users have taken laser safety course up to 3B.
6f. Beam delivery (abnormal operations): Class 4 laser hazard to eyes and skin inside beam delivery path.	All in room	Beam path to be as fully enclosed as practicable. Remove any watches or jewelry. Everyone must leave the room when using Class 4 unless they have had university Class 4 laser safety training and are working on the system in question (or being trained). Interlock system in place meaning laser will turn off if room doors are opened, and warning lights turn on outside the room.
6g. Laser process (normal operation): scattered radiation from target	Users, others in room	Beam path is fully enclosed within chamber. Interlock systems turn off laser if beam path is opened.
7a. High oxygen and high temperature environment are a fire hazard	Users, others in room	Pressure in chamber kept at or below atmospheric pressure Chamber is fully enclosed and sealed, and is opened until cooled.
8a. Use of a blade to remove sample	Users	User training for blade use Dispose of blades in sharps bin
9a. Inhalation of solvent vapor or dust	Users	Use of solvent reduces dry dust build up. Clean within fume hood.
9b. Solvent/dust contact with skin/eyes/mouth	Users	Use nitrile gloves, clean within fume hood.

**SECTION 2:** Emergency Procedures

Small solvent spill– dilute with water and mop up  
Large solvent spill – stop leak if without risk. Evacuate room. Absorb with dry earth/sand. Neutralize with sodium carbonate.  
Eye or skin contact with solvent or powder – flush area of contact with plenty of water, remove contact lenses if necessary, contact a First Aider, remove contaminated clothing.  
Inhalation of powder or excessive vapor – remove affected user to fresh air, contact a First Aider.  
Laser use – shut down laser at rear switch, or remove power via socked on gantry  
If gas sensor alarm sounds evacuate room

Signature of Assessor(s)		Date:
Signature of Supervisor		Date:

**SECTION 3:** Review - This assessment must be reviewed every 12 months or earlier if the basis of the original assessment is altered.

Review Date	Reviewed by (Signature)

Review Date	Reviewed by (Signature)