Department of Engineering – Risk Assessment Ref No. 8882

Title of project/experiment/activity Use of 3d printer SLA (Projet 1200)	
Location of activity Cambridge Graphene Centre : Ink Lab	**Start and end dates** 24/08/2015 - continuous

Brief description (or attach procedure/protocol)

The Projet 1200 is a commercially made stereo lithography 3d printer and will be used in accordance with the manufacturer's instructions after training. It is used to photo cure liquid polymer from a container (cartridge) and print 3d objects onto a moving platform.

Cartridges are filled and securely inserted inside the printer and the printer door is closed. The printing chamber is closed (metallic door) while printing and thus no curing light is visible to the user.

The printer is enclosed, and includes an interlock to prevent accidental contact with moving parts.

At the end of the printing procedure, the platform with the solidified composite part is removed then inserted in the curing chamber for a final photo curing of the part. The curing chamber is also closed and no light is visible for the user while final curing.

The cartridge is removed from the printer and cleaned in the Chemistry lab.

Hazard	Effect	Control measures	Residual risk
Exposure to liquid diacrylate polymer matrix	Irritation to the eyes and skin	The cartridges contain small volumes (<30ml) of liquid diacrylate polymer matrix. If spilt the user may become exposed. (Likelihood: 1, Severity: 1) Gloves, eye protection and lab coat must be worn whilst in the laboratory. The Ink Lab rules will be respected.	Low risk
General hazards in lab	Inhalation of solvents Exposure to chemicals harmful to health	The possible use of other chemical will be covered by dedicated risks assessments dealing with the preparation of nanomaterials composites and COSSH forms. Gloves, eye protection and lab coat must be worn whilst in the laboratory. The Ink Lab rules will be respected.	Low risk
Exposure to 405 nm wavelength projector and photocuring lamp	Damage to eyes and skin	The printer has a fully encased 405 nm (Blu-Ray) laser projector, and a secondary photocuring lamp. The printer must be used with the security doors closed. (Likelihood: 1, Severity: 2).	Low risk

Mechanical: The printer has moving parts leading to potential pinch points.	User may trap fingers. Mechanical damage to equipment	The printer must be used with the security doors closed. (Likelihood: 1, Severity: 1).	Low risk
Electric shock	Shock to user, damage to equipment	Do not get outer parts of the printer wet Always wipe any potential leakage inside or around the printer. (Likelihood: 1, Severity: 1)	Low risk

Personal Protective Equipment required [*eye/face protection, respiratory protection, gloves, lab coat etc*]

Lab coat, gloves (purple nitrile) and eye protection (safety specs) required in the lab at all times

Emergency Instructions & First Aid

Spillage:
Cartridges are filled in the Ink Lab. Spillage will be very small (<30 mL) and can be dealt with using a clean room wipes. Any leakage during printing will be contained within the printer enclosure.

Fire:
In case of fire, the fire alarm should be sounded and fire service called. If safe to do so, the fire may be extinguished using an extinguisher containing carbon dioxide, located in the corridor outside the laboratory.

First aid:
General advice: Consult a physician. Show this safety data sheet to the doctor in attendance.
If inhaled: If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.
In case of skin contact: Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.
In case of eye contact: Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

Any special monitoring required [*e.g. hearing test, vibration monitoring, health surveillance*]

No

Further control measures required? If yes, list with actions.

Waste Disposal Procedures: Cartridges are emptied into suitable non-chlorinated waste containers prior to cleaning. Cartridge emptying is performed in the fume cupboard in the Chemistry Lab.

In the case of equipment malfunction/failure: shutdown instrument from plug socket.

Biological/Laser/Radiation Approval [*requires relevant Specialist Safety Officer signature and date*]

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N/A
Out of hours/Lone working The system can can left running unattended and overnight, but will typically be used during normal hours. While printing unattended an „Attention running equipment / Keep away" notice should be displayed. People working around the printer have to make sure they wont disconnect the printer from the computer or the main power. Overnight running permit from Head of Division required.

Signature to confirm that this is a suitable and sufficient assessment of risk and that stated control measures are in place. This risk assessment should be reviewed if additional risks not covered in this assessment are identified or if there is any reason to indicate that the control measures are insufficient.

Name of Assessor Panagiotis Karagiannidis Email: pk412@cam.ac.uk	**Signature**	**Date** 31/8/2016
Name of Supervisor Prof A.C. Ferrari Email: acf26@cam.ac.uk	**Signature**	**Date** 2/11/16

Local Safety Coordinator	**Signature** David Hardy	**Date** 1/11/16.
Departmental Safety Office IAN SLACK	**Signature**	**Date** 9 NOV 2016

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Title of project/experiment/activity

Use of 3d printer SLA (Projet 1200)

Additional Users	Signature	Date
Abdul-Rahman Raji	[illegible]	05/09/16
AMR ABDELKADS	[illegible]	54/09/16
YUE LIN	[illegible]	05/09/16
Yuanlong Shao	[illegible]	05/09/16
Stephen Hodge	[illegible]	5/9/16
FLAVIA TOTTORELLI	Flavia Tavoli	5/9/16
Yayan. Yayan	YAR2AY	5/9/16
LUCIA LOMBARDI	Lucia Lombardi	5/9/16

Signatures to confirm that risk assessment has been read and understood.

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Title of project/experiment/activity Acrylate polymers.	
Location of activity Cambridge Graphene Centre : Chemistry/Ink Lab	**Assessment Reference**
Brief description (or attach procedure/protocol) **See Use of 3d printer SLA (Projet 1200) and Use of 3d printer polyjet (Projet 3500 HD plus) risk assessment and nanomaterial composite preparation risk assessment.**	
Chemical *Biological Agent*	**Hazard and Work Place Exposure Limits (WEL)**
Triethylene glycol diacrylate	Causes skin irritation. May cause an allergic skin reaction. Causes serious eye irritation. Exposure limits: LD50 Oral - rat - 813 mg/kg Muscle weakness, Ataxia, Changes in structure or function of salivary glands. LD50 Dermal - rabbit - > 3,000 mg/kg
Tricyclodecane dimethanol diacrylate	Causes skin irritation. Causes serious eye irritation. May cause respiratory irritation. Toxic to aquatic life with long lasting effects. No exposure limits
Phenylbis (2,4,6-trimethyl benzoyl)- phosphine oxide	May cause an allergic skin reaction. May cause long lasting harmful effects to aquatic life. No exposure limits
Urethane acrylate oligomers	Eyes: Can cause irritation consisting of redness, swelling and pain. Skin: Can cause irritation or other allergic reactions, including redness and/or swelling. Inhalation: Inhalation can cause respiratory irritation. Ingestion: Ingestion can cause nausea, diarrhea and/or stomach pain. Chronic: Can cause an allergic skin reaction with repeated or prolonged exposure consisting of redness, swelling and/or rash (urticaria). No exposure limits
Ethoxylated bisphenol A diacrylate	Causes skin irritation. May cause an allergic skin reaction. Causes serious eye irritation. May cause respiratory irritation. No exposure limits
	Causes skin irritation.

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Tripropyleneglycol diacrylate	May cause an allergic skin reaction Causes serious eye irritation. May cause respiratory irritation. Toxic to aquatic life with long lasting effects. No exposure limits
Poly (Methyl methacrylate)	Low toxicity under normal conditions of handling and use No exposure limits
Toluene (PMMA pellets may contain ≤2.0% toluene)	Flammable liquids Skin irritation Reproductive toxicity Specific target organ toxicity - single exposure Central nervous system Specific target organ toxicity - repeated exposure Aspiration hazard TWA 50ppm STEL 100ppm
Tetra(ethylene glycol) diacrylate	Harmful if swallowed. Causes severe skin burns and eye damage. Contains no substances with occupational exposure limit values.
Methyl methacrylate / n-Butyl methacrylate, methacrylic acid	Low toxicity under normal conditions of handling and use

Control Measures [*Fume Cupboard, glove box, safety cabinet, local exhaust ventilation*]

Prepare solutions containing acrylate in a solvent fume cupboard in the Chemistry lab. After the composites have been prepared they can be taken into the ink lab into a sealed container for use on commercial equipment equipped with exhaust is required.

Keep the solution containing polymers and monomers in a tight sealing container and open only in well ventilated laboratory (chemistry or ink lab).

Flammables and explosives

Is there a substance used or formed that might give rise to a fire or explosion? No

If yes, list control measures.

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A more detailed risk assessment will be required if the lower explosive limit is reached during leak or spillage.

Personal Protective Equipment [*Lab coat/overalls, gloves, eye/hearing/respiratory protection*]

Gloves, eye protection and lab coat must be worn whilst in the laboratory.

Monitoring [*Chemical, gas, oxygen depletion etc.*]
Not required.

Health surveillance required [*E.g. Carcinogen, mutagen, toxic to reproduction, sensitizer*]

Not required.

Storage

Triethylene glycol diacrylate and Tricyclodecane dimethanol diacrylate : Recommended storage temperature: 2 - 8 °C

Phenylbis (2,4,6-trimethyl benzoyl)- phosphine oxide, Urethane acrylate oligomers, Ethoxylated bisphenol A diacrylate, Tripropyleneglycol diacrylate : Store in cool and dry place. Keep container tightly closed in a dry and well-ventilated place.

Other acrylates: Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Keep away from heat and sources of ignition.

Tetra(ethylene glycol) diacrylate must be stored away from UV light.

Waste disposal [*Contractor, chlorinated, non-chlorinated, non-hazardous aqueous, general waste*]

All the wastes must be disposed in the appropriate disposal, most likely non-chlorinated wastes but if chlorinated solvent are use, the waste will go in the chlorinated wastes.

Emergency Procedure

In event of contact with eyes or skin immediately flush with copious amounts of water for at least 15 minutes after removing contaminated clothing. Call Reception for first aider. Inform Departmental Safety Office.

In case of SPILLAGE:
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

In case of FIRE:
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

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First Aid

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Out of hours/lone working

Out of hours/lone working permitted if authorised by Supervisor. Permission from Head of Division is required.

Assessment Summary

Gloves, eye protection and lab coat must be worn when handling the polymer listed above.

Signature to confirm that this is a suitable and sufficient assessment of risk and that stated control measures are in place and will be reviewed.

Assessor Dr. Panagiotis Karagiannidis Email: pk412@cam.ac.uk	**Signature**	**Date** 26/08/2016
Name of Supervisor Prof A.C. Ferrari Email: acf26@cam.ac.uk	**Signature**	**Date** 2/9/16

Reviewed by:

Local Safety Co-ordinator	**Signature** David Hanks	**Date** 21/11/16
Departmental Safety Officer IAN SLACK	**Signature**	**Date** 29 NOV 2016