# Department of Engineering – Risk Assessment Ref No. B459

**Title of project/experiment/activity**

**Synthesis and chemical reduction of graphene oxide**

| **Location of activity** | **Start and end dates** |
|---|---|
| Cambridge Graphene Centre : Chemistry Lab | 2015/11- continuous |

**Brief description (or attach procedure/protocol)**

Oxidizing graphite in the mixture of Sulfuric acid and KMnO4 below 60 °C result the highly soluble graphene oxide (GO). The experiment follows the procedure: (1) add graphite powder with sulfuric acid; (2) add $KMnO_4$ by portions at low temperature (note: below 5 °C) by ice water bath; (3) slowly heat to 50 °C; (4) dilute in large amount of water (note: pour the reactive mixture into ice water slowly, DO Not pour water into the mixture; (5) add $H_2O_2$ solution and HCl solution dropwise; (6) wash the mixture by water using centrifugation (Note: pour acidic waster into the specific waste bottle.

Reduction of GO involves the reductants, such as Hydrazine and HI, usually in solution or vapor at specific temperature (below 100 °C).

| Hazard | Effect | Control measures | Residual risk |
|---|---|---|---|
| Sulfuric acid | Causes severe skin burns and eye damage | Wear mask, specific protective gloves, glasses, and apron. | Low risk |
| Sulfuric acid/$KMnO_4$ | Possible explosion | 1. Add KMnO4 very slowly and by small portions (< 0.1 g) at low temperature (below 5 °C, as low as possible when using ice-water bath;<br>2. Do not heat the mixture to high temperature (below 60 °C) | Low risk |
| HCl | Causes severe skin burns and eye damage | Always use HCl in the acid cupboard under good ventilation. | Low risk |
| Hydriodic acid | Causes severe skin burns and eye damage<br>May cause respiratory irritation | Wear mask, specific protective gloves, glasses, and apron. | Low risk |
| Hydrazine hydrate solution | Toxic if swallowed, in contact with skin or if inhaled<br>Causes severe skin burns and eye damage.<br>May cause an allergic skin reaction.<br>Very toxic to aquatic life with long lasting effects. | 1. Wear mask, specific protective gloves, glasses, and apron.<br>2. Always use in the cupboard under good ventilation. | Low risk |
| Graphene oxide | Possibly toxic to aquatic life | Pour waste containing GO into the waste bottles. | Low risk |

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

Glasses, Mask, Anti-acid gloves and apron.

**Emergency Instructions & First Aid**

**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 outside the laboratory in the corridor.

**First Aid:**
General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.
If inhaled and 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. 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.

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

No

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

Get trained before experiments for two-times at least.

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

N/A

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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**<br>Dr. Stephen Hodge<br>Email: sah211@cam.ac.uk | **Signature** | **Date**<br>8/8/16 |
| **Name of Supervisor**<br>Prof A.C. Ferrari<br>Email: acf26@cam.ac.uk | **Signature** | **Date**<br>2/9/16 |

| | | |
|---|---|---|
| **Local Safety Coordinator** | **Signature**<br>David Hale | **Date**<br>13/4/17 |
| **Departmental Safety Office**<br>IAN SLACK | **Signature** | **Date**<br>24 APR 2017 |