





<b>Title of project/experiment/activity</b> <b>Soft-Etching using the Moorfield NanoETCH</b>			
<b>Location of activity</b> Cambridge Graphene Centre, Class 1000 Cleanroom, EEDB Annexe, 2nd floor		<b>Start and end dates</b> 1/7/2017 – open-ended	
<b>Brief description (or attach procedure/protocol)</b> <p>The Moorfield NanoETCH is a soft-etching tool that provides low plasma powers (&lt;30 W), with high control resolution. It is used for surface activation as substrate preparation for flake exfoliation and transfer, the clean removal of layered materials like graphene, and defect engineering in these materials.</p> <p>The system is suitable for accepting substrates up to 3" diameter. Substrates rest on a stage inside the vacuum chamber, and power is supplied from an RF unit.</p> <p>During operation, the nanoETCH supplies process gas (Argon, Nitrogen, Oxygen, Tetrafluoromethane) through MFCs. These, along with all other hardware, are controlled manually or automatically (recipe-based) via the touchscreen HMI.</p>			
			
<b>Hazard</b>	<b>Effect</b>	<b>Control measures</b>	<b>Residual risk</b>
Exposure to Gases; reactive and inert	Eye and skin irritations	After every etching process the machine will be pumped to base pressure (<5 x 10 <sup>-5</sup> mbar) before venting. All gas connections are checked regularly. Gas sensors for oxygen depletion are installed in the cleanroom and will detect any leakage early on.	Low
Exposure to radiofrequency (RF) radiation	Tissue damage due to RF heating	During the etching process an appropriate distance from the chamber will be respected, while after the process the machine will be pumped to base pressure (<5 x 10 <sup>-5</sup> mbar) before venting.	Very Low
<b>Personal Protective Equipment required</b> [eye/face protection, respiratory protection, gloves, lab coat etc] Appropriate cleanroom clothing (gloves, eye protection, over-boots, and lab coat) must be worn during the process. No additional PPE is required.			
<b>Emergency Instructions &amp; First Aid</b>			

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<p>If the gas alarms sound, the user is required to leave the cleanroom through the closest emergency exit.</p> <p>In case of exposure or the occurrence of irritations, see a medical professional.</p>
<p><b>Any special monitoring required</b> [e.g. hearing test, vibration monitoring, health surveillance]</p> <p>Gas sensors of all process gas (Argon, Nitrogen, Oxygen, Tetrafluoromethane) are installed in the cleanroom and serviced regularly.</p>
<p><b>Further control measures required?</b> If yes, list with actions.</p> <p>The guidelines for safe operation of the Moorfield nanoETCH provided by the manufacturer must be followed at all times.</p>
<p><b>Biological/Laser/Radiation Approval</b> [requires relevant Specialist Safety Officer signature and date]</p> <p>-</p>
<p><b>Out of hours/Lone working</b></p> <p>Out of hours working must be authorised according to Engineering Department regulation. Access to the process gases at out of hours will be restricted until then. Permission from Head of Division and Facilities Manager must be sought.</p>

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.

<b>Name of Assessor</b> Jakob Ewald Muench Email: jem227@cam.ac.uk	<b>Signature</b> 	<b>Date</b> 7/7/17
<b>Name of Supervisor</b> Prof. A.C. Ferrari Email: acf26@cam.ac.uk	<b>Signature</b> 	<b>Date</b>
<b>Facilities Manager</b> Dr Yury Alaverdyan Email: facilities@graphene.cam.ac.uk	<b>Counter-signature</b> 	<b>Date</b> 11/7/17

<b>Local Safety Coordinator</b>	<b>Signature</b> 	<b>Date</b> 11/7/17
<b>Departmental Safety Office</b> IAN SLACK	<b>Signature</b> 	<b>Date</b> 27 JUL 2017