Department of Engineering – Risk Assessment

Ref No. B890

Title of project/experiment/activity **Use of TA Q50 Thermogravimetric Analyser (TGA)**	
Location of activity Cambridge Graphene Centre, Ground floor: Energy Storage Lab	**Start and end dates** 01/08/2016 - continuous

Brief description (or attach procedure/protocol)

The Q50 TGA is a compact, general-purpose thermogravimetric analyser. It is equipped with a mass flow control, gas switching capability, and software. and must be used in accordance with the manufacturers instructions.

The heart of the TGA is the accurate and reliable vertical thermobalance housed in a temperature-compensated environment. The TGA balance provides accuracy and precision in weight change detection from ambient to 1000°C, low baseline drift, and sensitive, reliable operation over the entire weight range.

An efficient horizontal purge gas system allows accurately metered purge gas to flow directly across the sample, and is expertly integrated into a vertical thermobalance/furnace design. A regulated portion of the gas is also directed through the balance chamber to eliminate backflow, and the combined gases plus any sample effluent exit the system by a side arm. The design minimizes buoyancy effects, and optimizes removal of decomposition products from the sample area. The digital mass flow controllers improve data quality.

Various samples can be measured e.g. graphene, 2d materials, metal oxides, etc. (user should refer to personal risk assessments for sample handling).

Due to the variety of materials measured in the TGA, separate risk assessments must be carried out for every material measured in the instrument with consideration of sample form and size, aerosol/particle handling, material handling, toxicity, sensitivity, carcinogenicity, temperature, gaseous and non-gaseous products, etc. This list is only an indicator and not an exhaustive list of factors that need to be assessed.

Hazard	Effect	Control measures	Residual risk
General hazards in lab	Inhalation of solvents	Wash bottles containing volatile and combustible solvents, such as acetone, ethanol, and isopropanol, are present and used in the lab to clean items or equipment. (Likelihood: 1, Severity: 1) There is appropriate ventilation in place. The solvent will be contained in a wash bottle. Eye protection and lab coat will be worn while in the laboratory. The Energy Storage Lab rules will be followed.	Low risk
Electrical hazard	Electric shock	High voltages are present inside this instrument. Death can result from normal voltage of 240 V causing currents of greater than 30 mA to flow through the body for more than 40 ms. Minor shocks may also cause injury following involuntary muscle contraction. (Likelihood: 1, Severity: 3)	Low risk

		As a result, the instrument will not be opened by the user. Only a qualified technician or expert is allowed to open the instrument enclosure. The instrument must be unpugged before doing any maintenance or repair work that requires opening the cabinet covers.	
Chemical hazard	Fire; Inhalation of potentially toxic gases;	The sample atmosphere can be controlled during TGA experiments by connecting purge gases to the system. Purge gas is distributed separately to two parts of the TGA—the furnace (sample) and the balance chamber. High purity N_2 or air (chemical purity grade) is connected as purge gas for the instrument and used during experiments. No other gas must be used without a separate risk assessment. (Likelihood: 1, Severity: 1) Under no circumstances will hydrogen or any other explosive gas be used in the instrument. Corrosive gases shall not be used in this instrument. Oxygen may be used as a purge gas, but a separate risk assessment must be filed. In general, the furnace must be kept clean so that volatile hydrocarbons, which might combust, are removed. If a material that that lose a large amount of volatile hydrocarbons (e.g., lubricating oils), the furnace will be cleaned immediately after the experiment to prevent dangerous buildup of debris in the furnace. A separate risk assessment must be done for every material measured in the instrument. If measuring samples that may emit harmful gases, the gases must be vented through an exhaust. N_2 or air is used as a cooling gas before, during, or after experiments.	Low risk
Compressed gases	Explosion; Asphyxiation;	If the regulator fails, the gas is released suddenly with possible fatal consequences, but fortunately failures of regulators that have been purchased to the correct standard, and selected correctly for the service are rare. If a compressed gas cylinder tips over, causing the valve block to be sheared off, the rapid release of high pressure gas may cause the cylinder to be violently accelerated, potentially causing property damage, injury, or death. (Likelihood: 1, Severity: 3)	Low risk

		Where possible, a compressed lab gas supply is used. Otherwise, a size V cylinder is installed in the lab and chained to a rack to prevent falling and breaking. Specifically, lab N_2 is used as the cooling gas; a size V high purity lab N_2 and compressed air cylinders are available for use as process gas. Compressed lab gas supplies and cylinders for purging and cooling are equipped with suitable regulators. Installing and replacing gas cylinders will be done by trained personnel. Compressed gas poses asphyxiation hazard – a condition of severely deficient supply of oxygen to the body that arises from abnormal breathing – such as choking. This could be fatal. (Likelihood: 1, Severity: 3) Proper ventilation is maintained to prevent injury or death due to asphyxiation in case of leaks. Also, an oxygen monitor is located next to the BET instrument and will alarm if oxygen levels fall below 20%. The maximum combined purge rate in the instrument will be 100 mL per minute for your experiments. The flow distribution will typically be as follows: 40 percent to the balance chamber and 60 percent to the sample (furnace).	
Thermal hazard	Skin burn; Fire	During a sample run, the furnace base can be hot enough to burn skin. After experiment, the sample/sample holder may be very hot up to 1000 °C. If a sample is removed whilst the substrate holder is still hot, there is a risk of burns to the user. Also there is risk to damaging the system if the furnace is opened at temperatures >200 °C (Likelihood: 2, Severity: 3). Avoid contact with the furnace base during experiments. The equipment has a cooling apparatus and a safe operating procedure which can be integrated with the experimental protocol so that the burns risk and exposure to hot contents is avoided as long as the user follows the rules. Basically, the furnace will be cooled to room temperature before opening it. The cooling function will be entered at the end of the experimental protocol before running the experiment.	~~Low~~ risk MODERATE

		Wash bottles containing volatile and combustible solvents, such as acetone, ethanol, and isopropanol, are present and used in the lab. (Likelihood: 1, Severity: 2). All solvent bottles will be removed from the vicinity of the TGA before starting experiments. Solvent bottles will not be used near the TGA during experiments.	
Mechanical hazard	Collision; Pinch points	The TGA contains a moving part – the furnace, which may collide with body parts. (Likelihood: 1, Severity: 1). Fingers and all other objects will be kept out of the path of the furnace when it is moving.	Low risk

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

Lab coat and eye protection (safety specs) required in the lab at all times.

Emergency Instructions & First Aid

General advice: Consult a physician. Show this risk assessment to the doctor in attendance.

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

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

In the case of equipment malfunction/failure, you need to cut off the power supply. Merely closing the control software will not terminate the measurements. To cut off power from the instrument, the power switch is located at the rear of the instrument.

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

Out of hours/Lone working

Measurements may be run overnight. Once the measurement has been started, the instrument completes the measurements based on the preset procedure. An unattended experiment form must be filed by the user and signed by a designated super user of the TGA, the person in charge of the TGA, or the lab leader for such an experiment to be run. Also requires permission from Head of Division.

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.

Department of Engineering – Risk Assessment Ref No.

Name of Assessor Dr. Abdul-Rahman Raji Email: aror2@cam.ac.uk	**Signature**	**Date** 21/08/2016
Name of Supervisor Prof. Andrea Ferrari Email: acf26@cam.ac.uk	**Signature**	**Date** 21/9/16

Local Safety Coordinator	**Signature** D Hanke	**Date** 27/10/16
Departmental Safety Office IAN SLACK	**Signature**	**Date** 9 NOV 2016