London South Bank University
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School of Engineering

The School of Engineering at London South Bank University is an ambitious and progressive centre of research strength, ranked 25th nationally for research power in the last Research Excellence Framework. We have a fabulous central London location and are looking for talented potential students interested in research to work with our academic faculty in areas of strength. We are offering a number of funded PhD scholarships below. These studentships are available to UK nationals & EU citizen's and overseas applicants*. Those in possession of their own funding (e.g. via a non-EU government scholarship) are also welcome to apply for a place of study.

PhD Scholarships available in the London Centre for Energy in the School of Engineering:

1) **Modelling and simulation of the laser ablation process**
2) **Instrumented Nanoindentation for information rich electro-mechanical characterisation**
3) **The Rehbinder Effect across length scales**
4) **Finite element analysis and experiments on hybrid laser assisted machining processes**
5) **Highly Efficient Bifacial Organic Solar Cells**
6) **Thermally Activated Delayed Fluorescence (TADF) based Hyperflourescence OLEDs**

Further details on each PhD project as well as application information are provided via this link but all PhD scholarships benefit from the following:

- Training in advanced engineering topics
- Mentoring from industry on the application and context of research
- Bespoke technical training
- Enterprise and innovation skills training
- Transferable skills development opportunities to increase employability
- 3-year studentships of ~£15,000 per annum living stipend (tax free)
- Payment of all tuition fees*
- A school supported consumables and travel budget to support additional specialist research training courses, access to specialist equipment and travel to international conferences, seminars and workshops
- Industry sponsored* cutting-edge research projects
- Wide choice of PhD projects ranging from applied to blue-sky research
- State-of-the-art research facilities in the centre of London
- Opportunities for overseas secondments to industrial partners and universities
- Excellent career prospects on completion of the PhD

* for eligible students only

LSBU Research Centres Website: http://www.lsbu.ac.uk/research/centres-groups, please click on the link here to see the specific PhD posts available.
Closing date for applications: 15th of July 2020 **PhD Start:** 1st October 2020

Modelling and simulation of the laser ablation process

Project description:

LASERS are the backbones of present day innovative engineering applications. Ranging from eye surgery to manipulation of coatings and surfaces for biomedical implants and aerospace structures or for the creation of smart materials or nano materials, their application is widespread. The current capability to simulate LASER processes is constrained by the underlying physics and there exist some significant gaps in numerical simulation and real-world applications.

The ultimate **aim** of this project **is to improve the laser simulation capability using numerical modelling.** This will be accomplished by **developing a simple fundamental model of laser ablation of titanium metal as a testbed study** to support the idea that an ablation process can be predicted and that the damage occurring due to local heating can be controlled. An understanding of this will directly contribute to the medical sciences by improving the means of carrying out laser surgery and allow the design to be cost-effective for bio-medical implants which are widely manufactured using titanium alloys.

On this project, *the student will have a unique opportunity to gain familiarity with a new scientific simulation tool known as "Molecular Dynamics" simulations and "high performance scientific computing on local and national facilities". The project will take advantage of the software such as "LAMMPS and LIGGGHTS"* Furthermore, the project will be undertaken in partnership between the "School of Engineering at LSBU" as well as the "Orthopaedic Department" of NHS as well as EU based companies like Multitel and Lasea, and will be highly entertaining and rewarding from the future employment perspective.

This unique fully-funded full time PhD studentship supports students from any part of the globe and seeks highly talented candidate in this area. During the research stage, the student will have a chance to work with key players and be part of the research team developing new simulation tool to extend the existing knowledge in this area. The position offers unique opportunity to those who aim to build their career in the direction of analytical modelling skills or who prefer working remotely if they have exceptional professional or personal circumstances.

Supervisory Team: The successful applicant will be working Dr Saurav Goel who beside LSBU, also works for Cranfield University and University of Cambridge. He manages two Centres of excellence namely, "Centre for Doctoral Training in Ultra-Precision Engineering" and "Networkplus in Digitalised Surface Manufacturing". As part of this project, you will be benefitted by a wide range of training tools. Informal enquiries should be directed to Dr Saurav Goel (GoeLs@LSBU.ac.uk). As a PhD student, you will join the London Centre of Energy Engineering and work alongside a range of new and experienced PhD students in a collaborative environment.

Requirements: Applicants must be of outstanding academic merit and should have (or be expected to gain) either a first class or an upper second class Honours degree (or the international equivalent), or an MSc/MRes with distinction. Enthusiastic and self-motivated candidates from all countries with a background in either Engineering, Physics or Mathematics or a related discipline are encouraged to apply. Candidates should be able to demonstrate that they are highly motivated, have excellent communication skills and undertake challenging tasks using their own initiative. They should have willingness to go beyond what's just stated.

Instrumented Nanoindentation for information rich electro-mechanical characterisation

Nanoindentation (**ISO 14577 and ASTM E2546–07**) is a high resolution technique to precisely characterise the mechanical behaviour of various materials. Usually, the process of nanoindentation relies on pressing an unknown substrate by a sharp diamond tip. In its native form, the process of nanoindentation can be carried out in two modes i.e. load controlled and displacement controlled. The technique relies purely on establishing mechanical contact to deform the substrate.

With the advent of new materials, new capabilities are required to evaluate not just mechanical but also chemical and electric properties of the substrate. This is particularly useful to do a combined electro mechanical characterisation especially in situation where a contact mode mechanical loading may not be allowed as it can damage the smaller surfaces such as those obtained from the museum and in such cases a non-contact electrical characterisation may instead be performed.

Towards these thoughts a conductive atomic force microscopy has been developed in the past (https://doi.org/10.1063/1.5044518) however, it looks at very small samples, requires the probe to be conductive and is still destructive in nature.

A Nanoindentation machines comes equipped with a displacement control to precisely place a probe at a site as well fitted with a scanning microscope gives good information of the localised area. As part of this project activity, the aim here is to equip a nanoindenter with unprecedented capabilities, in particular to bring either a contact or non-contract electrical measurement capability which will boost the use of this technique for assessment of energy devices in solar area as well as that of functional coatings.

Thus, the ultimate **aim** of this project **is to instrument electrical capability into the newly bought nanoindentor at LSBU. An initial idea is to bring capacitive or impedance based measurement into place such that the indenter can probe a measurand like work function of the localised area. There is also an opportunity to bring an additional instrumentation for making a nanoindentation device to behave like an ultra-precision diamond milling system.**

On this project, *the student will have a unique opportunity to gain familiarity with the instrumentation process and to learn more about Kelvin probes and its utility in expensive electronic wafer manufacturing process. The project will have a deep involvement of the UK leading nanoindentation instrument manufacturing "Micro Materials Limited" who will provide necessary enabling training to work on the project.*

This unique fully-funded full time PhD studentship supports students from any part of the globe and seeks highly talented candidate in this area.

Supervisory Team: The successful applicant will be working Dr Saurav Goel who beside LSBU, also works for Cranfield University and University of Cambridge. He manages two Centres of excellence namely, "Centre for Doctoral Training in Ultra-Precision Engineering" and "Networkplus in Digitalised Surface Manufacturing". As part of this project, you will be benefitted by a wide range of training tools. Informal enquiries should be directed to Dr Saurav Goel (GoeLs@LSBU.ac.uk). As a PhD student, you will join the London Centre of Energy Engineering and work alongside a range of new and experienced PhD students in a collaborative environment.

Requirements: Applicants must be of outstanding academic merit and should have (or be expected to gain) either a first class or an upper second class Honours degree (or the international equivalent), or an MSc/MRes with distinction. Enthusiastic and self-motivated candidates from all countries with a background in either Instrumentation, Control, Engineering, Physics or Mathematics or a related discipline are encouraged to apply. Candidates should be able to demonstrate that they are highly motivated, have excellent communication skills and undertake challenging tasks using their own initiative. They should have willingness to go beyond what's just stated.

Understanding of the Rehbinder effect across length scales

Rehbinder in 1928 reported that when a wetted surface is brought into contact with a metallic surface, it results in reduction of surface energy and hence diminishing strength of the material (doi:10.1038/1641127a0). The theory in its native form has implications on many fields including machining, tribology (biomedical implants remain in contact with body fluid), imaging (ultra-sound imaging) and many more including turbine blades where a metallic part comes undergoes several wetting cycles. Rehbinder effect in essence, may result in elastic strain, defect formation, plastic failure, defect formation, diffusion and heat and mass transport – all of which would have implications on the tribological performance of many mating engineering components. It is likely that the Rehbinder effect will have a large implication on the coefficient of friction in a broader sense which would have deep effects across a more-wider range of scientific problems. However, it is not clear from the literature as to what role does effects like change in length (length scale) roughness, microstrength of the surface etc plays in influencing the Rehbinder effect.

The ultimate **aim** of this project **is to deepen the current understanding on Rehbinder effect using numerical modelling (Multiscale modelling using FEA and molecular dynamics) and experimental approaches (nanoindentation and single point diamond turning).** This will be accomplished by **developing a simple fundamental model of nano and micro scratch tests in presence of liquid media**. An understanding of Rehbinder will help augment measures necessary to overcome the strength degradation of metals as was earlier reported by Rehbinder.

On this project, *the student will have a unique opportunity to gain familiarity UK's national High performance computing platform like "ARCHER" and will work with a team of scientists at multiple research labs of global standards. The project will take advantage of the software such as "LAMMPS", "Abaqus" and LIGGGHTS".* Also, the project will largely also be benefitted by experiments performed at LSBU on a Nanoindentation device and that of Single point diamond machining experiments performed in the UK and in India thus bringing lot of travelling opportunities for the interested people. The project will involve several key EU wide companies such as Airbus, Rolls Royce, M-Solv, PVATepla, Stryker to name a few.

Supervisory Team: The successful applicant will be working Dr Saurav Goel who beside LSBU, also works for Cranfield University and University of Cambridge. He manages two Centres of excellence namely, "Centre for Doctoral Training in Ultra-Precision Engineering" and "Networkplus in Digitalised Surface Manufacturing". As part of this project, you will be benefitted by a wide range of training tools. Informal enquiries should be directed to Dr Saurav Goel (GoeLs@LSBU.ac.uk). As a PhD student, you will join the London Centre of Energy Engineering and work alongside a range of new and experienced PhD students in a collaborative environment.

Requirements: Applicants must be of outstanding academic merit and should have (or be expected to gain) either a first class or an upper second class Honours degree (or the international equivalent), or an MSc/MRes with distinction. Enthusiastic and self-motivated candidates from all countries with a background in either Engineering, Physics or Mathematics or a related discipline are encouraged to apply. Candidates should be able to demonstrate that they are highly motivated, have excellent communication skills and undertake challenging tasks using their own initiative. They should have willingness to go beyond what's just stated.

Finite element analysis and experiments on hybrid laser assisted high-speed machining

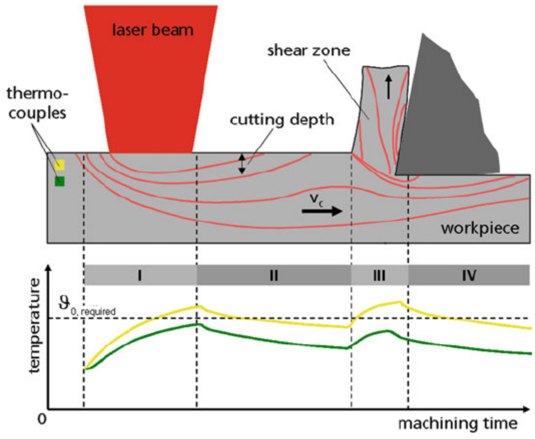

Figure 1: Schematic illustration of laser hybrid

Depending on the specifications (type, pulse, energy and power), a Laser can either be used for efficient material removal, forming, bending, joining or for deposition. Due to being such a versatile tool and the fact that is a contact-less manufacturing method, laser manufacturing has gained world-wide attention. A lot of research in the past has been done on improving our understanding on the laser-matter interaction but the subject is so rich in knowledge that is still offering many new insights and has continued to remain one of the most researched area in manufacturing at present. A hybrid manufacturing method relying on laser assistance is lately gaining popularity. It is also called as thermally assisted machining. The method relies on traversing a laser source ahead of the cutting tool. The presence of laser heating just ahead of the cutting makes the cutting material more compliant and amenable to be machined especially, difficult-to-cut metal alloys. The laser source by preheating the material, enhance plasticity by the virtue of thermal softening. While the concept, its principal and a limited understanding on this laser hybrid machining process exist, a lot of questions are still unanswered such as:

1. What should be the ideal horizontal gap between a laser source and the tool tip?
2. Is this distance dependent on the strain rate applied during cutting?
3. What is the correlation between the laser parameters, cutting speed and material's absorptivity?
4. Can a combination of laser heating and high pressure jet coolant be used to improve the machinability even more than what is usually achieved by simple laser machining?
5. In light of the recent knowledge (https://openresearch.lsbu.ac.uk/item/88v54) which suggests that at specific laser wavelengths, the absorptivity of material decreases with increased temperature can the laser energy be saved to make the operation energy efficient?

To answer such questions, the project will aim to use analytical and numerical models in conjunction with the experiments to unravel and elucidate fresh insights onto the laser assisted cutting process. **On this project,** *the student will have a unique opportunity to gain familiarity with ABAQUS numerical FEA modelling as well as performing cutting experiments.*

Supervisory Team: The successful applicant will be working Dr Saurav Goel who beside LSBU, also works for Cranfield University and University of Cambridge. He manages two Centres of excellence namely, "Centre for Doctoral Training in Ultra-Precision Engineering" and "Networkplus in Digitalised Surface Manufacturing". As part of this project, you will be benefitted by a wide range of training tools. Informal enquiries should be directed to Dr Saurav Goel (GoeLs@LSBU.ac.uk). You will also join the London Centre of Energy Engineering and work alongside a range of students as a team member.

Requirements: Applicants must be able to demonstrate merit and willingness to learn and should have (or be expected to gain) either a first class or an upper second class Honours degree (or the international equivalent). Enthusiastic and self-motivated candidates from all countries with a background in either Engineering, Physics or Mathematics or a related discipline are encouraged to apply. Candidates should be able to demonstrate that they are highly motivated, have excellent communication skills and undertake challenging tasks using their own initiative.

PhD Scholarship in Highly Efficient Bifacial Organic Solar Cells

Description: There has been an alarming increase in the atmospheric CO_2 content since the mid-19th century primarily due to the use of fossil fuels for energy generation. Significant portion of this is associated with the transport sector, the building sector also accounts for a large portion of energy. According to the Energy Performance of Buildings Directive by the European Commission (2019), 40% of the total energy consumption in Europe is due to growth in population and the building sector. This has led to the adoption of renewable energy sources for power generation for the building sector. The majority of the solar cells available to the consumer use the classical silicon-based photovoltaic technology, which is expensive and generates very low power under indoor lighting conditions, making it less attractive for indoor energy harvesting. Therefore, there is a need for a technology that enables high power outputs under both indoor and outdoor lighting while being capable of incorporation into building components.

Organic photovoltaics (OPVs) are expected to play a major role in future power generation because of their capability to deposit solar cells on flexible substrates by printing from solution or spray-coating. Flexible OPVs solar modules are now becoming commercially available and the first large-area installations have been demonstrated for outdoor and indoor power generation. However, these modules are produced by thermal evaporation in a vacuum which is an expensive technology. This project aims to develop novel active and interface materials to make low-cost and next-generation flexible bifacial organic solar cells by solution methods (ink-jet printing or spray-coating) for both outdoor and indoor energy harvesting.

The outcomes of this project for the PhD candidate are listed below:

- Investigate the photophysical properties using transient optical spectroscopies;
- gain experience in time-resolved spectroscopy and other characterisation techniques;
- develop the strategies to enhance light absorption, charge generation and extraction;
- fabrication and characterisation of highly efficient bifacial solar cells using non-toxic organic materials;
- present the findings of the project in international conferences;
- perform high-quality research and publish it as journal articles.

This will be a 3 .5-year fully funded studentship for an EU/UK and overseas applicants who are keen to conduct research in the development of renewable energy sources at LSBU in the School of Engineering.

Supervisory Team: The successful applicant will be working with Dr Tariq Sajjad (https://scholar.google.co.uk/citations?user=cN5jPLMAAAAJ&hl=en) at LSBU. As a PhD student, you will join the London Centre for Energy Engineering (http://www.lsbu.ac.uk/research/centres-groups/advanced-materials) and work alongside a range of new and experienced PhD students in a collaborative environment.

Informal enquiries should be directed to Dr Tariq Sajjad (sajjadt@lsbu.ac.uk). Please send a copy of your CV with a covering letter directly to Dr Tariq Sajjad before applying.

Requirements: Applicants must be of outstanding academic merit and should have (or be expected to gain) either a first class or an upper second class Honours degree (or the international equivalent), or an MSc/MRes with distinction. Enthusiastic and self-motivated candidates from all countries with a background in either Material Science, Chemistry, Physics, Engineering or a related discipline are encouraged to apply. A good knowledge or experience in Material characterisation along with device fabrication would be advantageous.

PhD Scholarship in Thermally Activated Delayed Fluorescence (TADF) based Hyperflourescence OLEDs

Description: Currently lighting is consuming more than 20% of total global energy due to energy inefficient lighting source. The development of efficient lighting sources will not only have economic impact but will also address the urgent need to reduce carbon emissions.

Organic light-emitting diodes (OLEDs), a multibillion pound market has the potential to provide cheap and clean solid-state lighting with minimal environmental impact. The devices with heavy metal-induced spin-orbital coupling effect, i.e. phosphorescence emitters, and purely organic TADF emitters, are now regularly been reported with more than 20% external quantum efficiencies. However, due to the nature of charge transfer and long exciton lifetime, many devices exhibited broadband emission profiles and serious efficiency roll-offs, this will sacrifice the colour purity for high-performance displays and efficiency loss at high brightness.

This PhD project, joint between LSBU, University of St Andrews and industrial partner "Edinburgh Instruments Ltd", aims to solve above mentioned problems via sensitization process by separating the exciton generation and recombination sites. For that, PhD student will design, synthesize, and screen the thermally activated delayed fluorescence (TADF) compounds with short exciton lifetimes, high radiative and reverse intersystem crossing rate as the sensitizers. To efficiently sensitize an emitter, the project aims to correlate the energy transfer efficiency with the quantum yield, rate constants of the sensitizer.

The outcomes of this project for the PhD candidate are listed below:

- synthesis of highly efficient TADF sensitizer;
- gain experience in time-resolved spectroscopy and other characterisation techniques;
- perform experimental measurements to develop the general rules of a good TADF sensitizer;
- fabrication of highly efficient Hyperflourescence OLEDs;
- present the findings of the project in international conferences;
- perform high-quality research and publish it as journal articles.

This will be a 3.5-year fully funded studentship for an EU/UK and overseas applicants who are keen to conduct research in TADF Hyperflourescence OLEDs at LSBU in the School of Engineering and also willing to travel to St Andrews and Edinburgh.

Supervisory Team: The successful applicant will be working with Dr Tariq Sajjad (https://scholar.google.co.uk/citations?user=cN5jPLMAAAAJ&hl=en) at LSBU, Prof Eli Zysman-Colman (https://scholar.google.co.uk/citations?hl=en&user=PtoQFloAAAAJ) at St Andrews and Alistair Rennie at Edinburgh Instruments, who aim to develop new emitters for lighting and communication. As a PhD student, you will join the London Centre for Energy Engineering (http://www.lsbu.ac.uk/research/centres-groups/advanced-materials) and work alongside a range of new and experienced PhD students in a collaborative environment.
Informal enquiries should be directed to Dr Tariq Sajjad (sajjadt@lsbu.ac.uk) or Alistair Rennie (Alistair.Rennie@edinst.com). Please send a copy of your CV with a covering letter directly to Dr Tariq Sajjad before applying.

Requirements: Applicants must be of outstanding academic merit and should have (or be expected to gain) either a first class or an upper second class Honours degree (or the international equivalent), or an MSc/MRes with distinction. Enthusiastic and self-motivated candidates from all countries with a background in either Material Science, Chemistry or Physics or a related discipline are encouraged to apply. A good knowledge or experience in Material synthesis, material characterisation along with device fabrication would be advantageous.