Department of Chemical Engineering
School of AACME

Loughborough University

Research Associate in *Mathematical Modelling and Optimisation of Chemically Controlled Hollow Microneedles for Drug Delivery*

Fixed term for 12 months with the possibility to be extended by 12 to 24 Months

Project Title: Mathematical Modelling and Optimisation of Chemically Controlled Hollow Microneedles for Drug Delivery

Job Ref:REQ240150

As part of the University's ongoing commitment to redeployment, please note that this vacancy may be withdrawn at any stage of the recruitment process if a suitable redeployee is identified.

Project Description

Loughborough University is working collaboratively with Queen's University Belfast (QUB) to develop the next-generation hollow microneedle systems for drug delivery. The project is funded by the Engineering and Physical Sciences Research Council (EPSRC), UK.

Traditional pharmaceutical drugs are small molecules that treat the symptoms of a disease. Biopharmaceuticals are larger molecules, for example, peptides, proteins and antibodies, which target the underlying mechanisms and pathways of a disease that are not accessible with traditional drugs. Therapeutic peptides, proteins and antibodies are expected to be used extensively in the coming years as vaccines and as treatments for cancer, high blood pressure, pain, blood clots and many other illnesses. However, one of the major challenges to successful clinical use of these so-called "biotech" molecules is their efficient delivery to the site of action.

In order to address these challenges, a novel type of transdermal patch, based on chemically controlled hollow microneedles, that can bypass the skin's barrier layer (stratum corneum) is being developed. The patch creates tiny holes in the stratum corneum, through which the biopharmaceuticals can enter the body from a reservoir system powered by simple and safe chemistry. The development of this technology relies on a combination of experimental and theoretical/modelling that will provide a full understanding of how these systems perform.

This project aims to develop a numerical framework for modelling and optimising chemically controlled hollow microneedles for drug delivery, in combination with the experimental components to be conducted at QUB.

Job Description

Job Grade: Specialist and Supporting Academic Grade 6

Job Purpose

To develop a numerical modelling framework for skin and chemically controlled hollow microneedles and verify the modelling schemes with experimental data provided by the partner university (QUB).

Job Duties

- To advance the candidate's knowledge of chemically controlled hollow microneedle systems
- To synthesise and analyse raw experimental data from the project collaborator (Queen's University Belfast, Belfast).
- To develop a framework for numerical simulations of chemically controlled hollow microneedles on the basis of mass, momentum and energy conservation laws, and relevant reactive mechanisms.

- To carry out numerical simulations of (i) single and two-phase fluid flow, (ii) drug transport, (iii) liquid and gas phase reactions and (iv) solid-fluid interactions for chemically controlled hollow microneedles
- To develop a framework for numerical simulations of drug release from chemically controlled hollow microneedles into the skin and, carry out numerical simulations on the basis of the developed framework.
- To synthesise and analyse all numerical modelling results in discussion with the project team.
- Be responsible for conducting the day-to-day running of the project in a safe and ethical manner.
- To formulate detailed plans for the project based on broad guidance from the project team.
- To keep regular contact with the project team on a weekly basis (lead investigator and other collaborators)
- To travel to the partner university when required and asked.
- To prepare regular minutes of project meetings with the project supervisors and carry out tasks as advised.
- To give feedback to the project team on progress on a regular basis and to make recommendations for the next steps.
- To write up monthly progress reports and present outcomes to all investigators and collaborators.
- To support the project team by enhancing relationships with the collaborator (collaborator)
- To contribute ideas for new research and enterprise directions.
- To coauthor review and research papers for dissemination on a regular basis in full agreement with the project team.
- To always maintain confidentiality and ensure that intellectual property (IPR) agreements are not violated.
- To engage in training programmes at the University (or elsewhere) that are consistent with the project's and the department's needs and aspirations.
- To undertake other duties as may be reasonably requested and that are commensurate with the nature and grade of the post.

Points To Note

This job description indicates the general level of duties and responsibilities of the post. The detailed duties may vary from time to time without changing the general character or level of responsibility entailed.

Special Conditions

All staff have a statutory responsibility to take reasonable care of themselves, others and the environment and to prevent harm by their acts or omissions. All staff are therefore required to adhere to the University's Health, Safety and Environmental Policy & Procedures.

All staff should be committed to observing the University's Equality and diversity policy and procedures at all times. Duties must be carried out in accordance with relevant equality and diversity legislation and University policies/procedures.

Successful completion of probation will depend on attendance at the University's mandatory courses, which include Respecting Diversity and, where appropriate, Recruitment and Selection.

Organisational Responsibility

Reports to **Dr DB Das**, FHEA, FRSB, FRSC, Reader in Porous Media, and project supervisor.

Person Specification

Your application will be reviewed with respect to meeting the essential and desirable criteria listed below. Applicants are strongly advised to explicitly state and evidence how they meet each of the essential (and desirable) criteria in their application. Stages of assessment are as follows:

1 – Application
2 – Test/Assessment Centre/Presentation
3 – Interview

Essential Criteria

Area	Criteria	Stage
Experience	Experience in setting up frameworks for data analysis (e.g., Excel, SPSS) and numerical modelling (e.g., COMSOL; MATLAB).	1, 2, 3
	Experience in numerical modelling of biological materials (e.g., skin).	1, 2, 3
	Experience in numerical modelling of fluid flow and mass transport in engineering systems.	1, 2, 3
	Recent science and/or engineering research experience in an academic environment	1, 2, 3
	Experience with the concepts of microneedle drug delivery systems	1, 2, 3
	Experience of working in research project(s) at the doctorate level	1, 2, 3
Skills and abilities	Ability to formulate and analyse previous methods for microneedle drug delivery	1, 3
	Understanding of the mechanics of biological materials (e.g., skin)	1, 3
	Ability to set up and execute a research agenda and communicate to various audiences and stakeholders	1, 3
	Excellent written and oral communication skills	1, 2, 3
	Self-motivated with the ability to meet deadlines	1, 3
	Excellent interpersonal, and organisational skills	1, 3
	Ability to plan project activities, write project interim and final reports and make technical presentations to industrial and academic research groups	1, 3
	Knowledge of relevant Health & Safety issues	1, 3
Training	Demonstrate evidence of having undertaken further training	1, 3
Qualifications	A PhD degree in science or engineering is required. Evidence of thesis submission is acceptable as a completion of the PhD.	1, 3
Other	Commitment to observe the University's Equal Opportunities policy at all times.	1, 3

Desirable Criteria

Area	Criteria	Stage
Experience	Experience in numerical modelling of the following mechanisms in engineering systems such as narrow channels and capillaries: (i) Single and two-phase fluid flow (ii) Particle transport (iii) Liquid and gas phase reactions (iv) Solid-fluid interactions	1, 2, 3
	Experience in numerical modelling of mechanics of biological materials (e.g., skin).	1, 2, 3
	Experience with previous research publications and presentations in meetings.	1, 2, 3
	Knowledge of numerical modelling software (e.g., COMSOL, MATLAB)	1, 2, 3
	Ability to plan and organise own workload effectively	1, 2, 3
	Working in a high-quality academic research environment	1, 2, 3
Skills and abilities	Experience in knowledge exchange-related activities	1, 2, 3

	Ability to communicate and liaise with other project partners	1, 2, 3
Qualifications	Experience working at a PhD level in the relevant subject area	1, 2, 3
Other	Willing to work on time is extremely essential due to the short nature of the project.	1, 2, 3

Conditions of Service

The position is full-time (1 FTE) and fixed term for 12 months initially.

The salary will be on Specialist and Supporting Academic Grade 6 (£33,966 - £44,263), spine point of 29 or above, which will be confirmed when an appointment is offered.

The appointment will be subject to the University's normal Terms and Conditions of Employment for Academic and Related staff/Operational and Administrative staff, details of which can be found here.

The University is committed to enabling staff to maintain a healthy work-home balance and has a number of family-friendly policies which are available at http://www.lboro.ac.uk/services/hr/a-z/family-leave-policy-and-procedure---page.html

We also offer an on-campus nursery with subsidised places, subsidised places at local holiday clubs and a childcare voucher scheme (further details are available at: http://www.lboro.ac.uk/services/hr/a-z/childcare-information---page.html

In addition, the University is supportive, wherever possible, of flexible working arrangements.

We also strive to create a culture that supports equality and celebrates diversity throughout the campus. The University holds a Bronze Athena SWAN award which recognises the importance of support for women at all stages of their academic career. For further information on Athena SWAN see http://www.lboro.ac.uk/services/hr/athena-swan/