Developing therapeutic materials for the treatment of diabetic wounds

Principal supervisor

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Location The Open University, Milton Keynes, United Kingdom

Full-time only

Duration & Funding 3 year 3 month studentship as part of EPSRC Doctoral Training Partnership; Stipend £18,622 per annum; Training grant £4,500

Application due date: Feb 2nd, 2024

Notification of shortlisting: Feb 9, 2024

Interview: Feb 23, 2024 on Microsoft Teams (can be flexible on date if needed)

Final Funding Decision: Late April/early May 2024**.** This is part of a pooled EPSRC-DTP process, so the selected applicant will be put forward to a reviewing panel in April for final decisions. Applicants will be notified if they are selected, and will be informed of the panel decision afterwards.

Start date: October, 2024

Science-related enquiries: <Nicholas.chatterton@open.ac.uk>

Process-related enquiries: <STEM-LHCS-phd@open.ac.uk>

Research area/keywords: Materials synthesis, wound care, diabetes

Project background and description

Project highlights:

- Interdisciplinary project with an opportunity to make an impact on a global health issue.

- Collaboration with medical practitioners from the UK and Egypt
- Develop expertise in a wide range of materials science, engineering, chemistry, and biology laboratory techniques.

Background

The impairment of wound healing is considered one of the major complications of diabetes.[1] Diabetic wounds can lead to amputations or sometimes death, with a 5-year mortality rate for patients with diabetic foot ulcers comparable to that of cancer.[2] Developing countries in the Middle East and North Africa (MENA), including Egypt, have the highest global prevalence of diabetes. The prognosis is that the situation will get worse in MENA countries, with the prevalence of diabetes expected to grow by 96% by 2045.[3] As a result, there is an imperative need for effective treatments of chronic wounds in diabetic patients.

Wound dressings containing metal oxide nanoparticles (MONPs) are thought to offer a possible solution.[4] Certain MONPs are particularly attractive as they have broad antimicrobial activity, generating reactive oxygen species which target multiple cellular mechanisms simultaneously, thus reducing the probability of bacteria developing resistance.

Project Aim

A range of materials platforms will be explored as potential carriers of MONPs. These include films based on hydrogels, meshes synthesised by electrospinning and 3D printing. By judicious tailoring of these materials, the release properties will be optimised to generate a sustained release of MONPs. Sustained release not only helps to avoid overdosing of patients but has the potential to extend the lifespan of a single dressing, thus reducing hands-on time for healthcare professionals and associated costs. Additionally, the effect of spatial distribution of the MONPs within the dressings will be explored, a crucial factor in the implementation of personalised wound care formulations. The antimicrobial efficacy of the dressings will be assessed against clinical specimens isolated from diabetic patients throughout the PhD project. This aspect will involve close collaboration with clinicians in both Egypt (Cairo University) and the UK (Milton Keynes Hospital). The overarching aim is to develop a wound care dressing that can be produced on demand at the point of care for individual patients. The findings from this project will bring this aspiration closer to reality.

References

1. J.M. Bunza and A. J. Alhassan, "Complications of Diabetes Mellitus: An Insight into Biochemical Basis," Eur. J. Pharm. Med. Res., vol. 6, no. 2, pp. 114‑120, 2019.
2. D. G. Armstrong, M. A. Swerdlow, A. A. Armstrong, M. S. Conte, W. V. Padula, and S. A. Bus, "Five year mortality and direct costs of care for people with diabetic foot complications are comparable to cancer," J. Foot Ankle Res., vol. 13, no.1, pp. 2‑5, 2020, doi: 10.1186/s13047-020-00383-2
3. I. M. El-Kebbi, N. H. Bidikian, L. Hneiny, and M. P. Nasrallah, "Epidemiology of type 2 diabetes in the Middle East and North Africa: Challenges and call for action Imad," World J. Diabetes, vol. 15, no. 9, pp. 1401‑1425, 2021.
4. Y. Abo-zeid and G. R. Williams, "The potential anti-infective applications of metal oxide nanoparticles: A systematic review," *Wiley Interdiscip. Rev. Nanomedicine Nanobiotechnology*, vol. 12, no. 2, pp. 1–36, 2020, doi: 10.1002/wnan.1592.

Eligibility

1. Applicants will ideally have a First Class or Upper Second undergraduate degree or Masters degree (or equivalent experience) in an area related to the project (e.g. materials science, bioengineering, chemical engineering, chemistry, pharmacy, microbiology)

2. The student would be required to live in the UK and within commuting distance to The Open University in Milton Keynes.

Desirable Criteria

1. A can-do attitude to solving problems.

2. Aptitude for learning new laboratory techniques.

3. Excellent communication skills

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Please submit to <departmental collection email> an:

- application form, and

- 2-page (A4) personal statement outlining your suitability for the studentship, what you hope to achieve from the PhD and your research experience to date

You do not need to submit a research proposal.

Information and the application form is found here: https://www.open.ac.uk/postgraduate/research-degrees/how-to-apply/mphil-and-phd-application-process. Note that as part of the application form, you will be asked to submit further documents (CV, degree transcripts, etc.)