A World Leading SFI Research Centre for Medical Devices

Science Foundation Ireland For what's next

MedDevDoc Marie Skłodowska-Curie PhD Fellowship

Self-powered Controlled Release Devices

Enzymatic biofuel cells[1] (EBFCs) possess potential for use in implantable medical devices. EBFCs possess advantages such as the use of enzymes in place of metals used in batteries, while disadvantages include low operational stability and low output voltages that hinder their use as power sources. Self-powered devices have the potential to overcome these disadvantages. Responsive polymer-based drug delivery systems have been described, with the potential to act as "sense-act-treat" devices[2]. Such systems generally use cathodes such as a metal ion (M^{n+})-cross-linked alginate polymer loaded with drug molecules. We have recently described the preparation of a self-powered drug release system based on an EBFC containing polymer modified electrodes that enabled controlled release of materials without an external electrical input. Initial experiments focussed on the model compounds, fluorescein and 4',6-diamidino-2-phenylindole and prototype devices were then successfully used for the controlled release of the analgesic, ibuprofen[3] and the antibiotic, ampicillin[4] in *ex vivo* conditions. This project will focus on the development of polymer modified electrodes for the controlled release of large, protein-based therapeutics with subsequent incorporation of the electrodes into a self-powered biofuel cell. The project will use a small (insulin) and a large (IgG) protein to demonstrate feasibility, prior to selecting target proteins from across the clinical pillars of CÚRAM (www.curam.ie).

The project is part of the MedDevDoc programme (funded under Marie Skłodowska-Curie (MSCA), grant agreement no. 101126640) to train 25 biomedical doctoral candidates in multidisciplinary, intersectoral, and transferable skills for the development of next-generation medical devices. A salary of €30,900 per annum will be paid (living and mobility allowance with an additional family allowance of €6,828 payable to students with family obligations). The project will be supervised by Professor Edmond Magner at the Bernal Institute, University of Limerick. Candidates should possess a 1st class or a upper second class honours degree or equivalent qualification in Chemistry, Biochemistry, Biomedical Engineering or a related discipline. Applications from candidates who have or are enrolled in M.Sc./M.Eng. programmes are welcome. Candidates must comply with MSCA rules and not have been resident in Ireland for more than 12 months in the last three years and must not hold a doctoral degree. Candidates should submit a CV detailing their academic record (3 pages maximum) together with a letter (1 page) describing their interest and motivation for the position to: Prof. Edmond Magner at edmond.magner@ul.ie, to whom informal enquiries can be addressed.

References

1. Xiao, X., Xia, H., Wu, R., Bai, L., Yan, L, Magner, E., Cosnier, S., Lojou, E., Zhu, Z. Liu, A., *Chem. Rev.*, 2019, **119**, 9509-9558.
2. Mailloux, S.; Halámek, J.; Halámková, L.; Tokarev, A.; Minko, S.; Katz, E.,*Chem. Commun.* **2013,** *49* (42), 4755-4757.
3. Xiao, X.X., McGourty, K.D., Magner, E. *J. Amer. Chem. Soc.*, 2020, **142**, 11602-11609
4. Xiao, X.X., Ryan, M.P., Leech, D., Zhang, J.D., Magner, E. *Chem. Comm.*, 2020, **56**, 15589 – 15592.

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