Project Details	
Project Code	MRCNMH26Ca Duc
Title	A High-Efficiency and Sustainable Next-Generation Nanotherapeutic platform to Improve Astrocytoma Outcomes
Research Theme	NMH
Project Type	Wet lab
Summary	In 2023, the Welsh and UK Government emphasised the urgent need for a strategic plan prioritising research in brain tumour therapy. Astrocytoma, comprising 1/3 of UK brain tumours, impact both children (mainly low-grade) and adults (can be high-grade e.g. glioblastomas with poor survival), stressing the need for better treatments and quality of life(QoL). This research aims to develop innovative functionalized nanocellulose-isothiocyanate nanoparticles drug-delivery platform (FNP) capable of effectively crossing the blood-brain-barrier(BBB) due to distinctive electroactive properties and effectively inducing targeted anti-tumoral effect on astrocytoma cells and favour neural regeneration. We will also explore electrical stimulation for enhancing FNP drug-delivery across BBB.
Description	**1.Background** In 2023, the Welsh and UK Government emphasised the urgent need for a strategic plan to prioritise research in brain tumour therapy[1]. Astrocytoma, comprising 1/3 of UK brain tumours (including Wales), impact both children(mainly low-grade) and adults(can be high-grade e.g.glioblastomas with dire survival rates), stressing the need for better treatments and quality of life(QoL)[2,3]. **2. Research Aims** This research aims to: A. Develop an innovative functionalized nanocellulose isothiocyanate nanoparticle platform (FNP) drug-delivery system capable of: -Effectively crossing across the blood-brain-barrier(BBB) due to distinctive electroactive properties -Inducing targeted anti-tumoral effect on astrocytoma cell lines (low-grade and high-grade) through specific derivatives delivery and favour neural tissue regeneration B.Explore electrical stimulation(ES) for enhancing NP drug-delivery across BBB in vitro(Fig.1). **3.Research Leading to Project** Current developments in sustainable composite natural biomaterials have propelled their application in advanced drug-delivery, including for astrocytoma therapy[REF]. Our previous work showed the potential of carbon-based nanobiomaterials in electrical stimulation (EP) of neural tissue and neural tissue regeneration[4-6]. Here, we aim to explore sustainable tailor-made bionanomaterials, namely functionalized nanocellulose isothiocyanate nanoparticles(FNP), as drug-delivery nanosystems that can cross the BBB and be controlled by electrical stimulation. Dr.P. Prokopovich (PP), developed machine-learning methods for designing advanced nanoparticles[8,9]. Dr. S. Jones (SJ) shaped robust techniques for validating BBB-trafficking[10]. Dr K. Wedgewood (KW) further developed robust electrophysiological techniques to measure and model neural cell activity and neural cell networks under various disease conditions[25,26].

4. Doctoral Training

The doctoral candidate will gain skills and expertise in neural technologies, electrical stimulation and advanced nanoparticles development for brain cancer therapy

Research Skills and Techniques – Training includes advanced novel nanoparticle design and synthesis, nanobiomaterials characterisation, in vitro neural models, neural cell culture, microscopy, electrical stimulation and in vitro neural electrophysiology.

Academic and Research Excellence – Cardiff University, as part of the Russell Group, focusses on Research and Academic Excellence. As a doctoral researcher, the candidate will benefit from academic and research skills training delivered by the Cardiff Doctoral Academy.

Innovation and Entrepreneurship– Cardiff University hosts SPARK, home to Research Innovation at Cardiff where the doctoral candidate can have access to innovation and entrepreneurship training.

5. Supervisory Team

The supervisory team that will support the doctoral candidate is an exciting multidisciplinary team with unique expertise in nanoparticles-design, synthesis and biological characterisation (Dr Daniela Duc and Dr Polina Prokopovich), electrical stimulation (Dr Daniela Duc) neural cell electrophysiology and activity modelling (Dr Hyle Wedgewood) and cancer cell biology (Dr Samuel Jones).

6. Research Environment and Collaboration

The Research Environment at Cardiff University aims to foster a positive research culture that is diverse, inclusive, supportive and collaborative. The research will be hosted by the School of Pharmacy and Pharmaceutical Sciences at Cardiff University. The multidisciplinary nature of the research in our school benefits from worldwide collaborations that enable us to see the real-world impact of our research. Our range of research facilities offers key technologies to address the needs of our research community.

This research project will be done in collaboration with the Living Systems Institute (Dr Kyle Wedgewood) at the University of Exeter, UK. There, the doctoral candidate will be able to learn and gain valuable experience in bespoke neural electrophysiology techniques and advanced analysis of neural electrophysiology data.

7. Equality, Diversity and Inclusion

We welcome applications from all people irrespective of age, disability, sex, gender identity, sexual orientation, marital or civil partnership status, pregnancy or maternity, race, religion and belief. We greatly encourage applications from under-represented groups.

Informal enquiries can be made to **Dr Daniela Duc** at ducd@cardiff.ac.uk

Please use the link below to view the References used in this text:

https://cf-my.sharepoint.com/:w:/g/personal/ducd_cardiff_ac_uk/ETcI-7eUi2RFnXnyJpU-qS8Bss0BOEiTVr3KYBXaueRtIQ?e=kjh2eT

Supervisory Team	
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