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NTU’s Smart Breakthroughs for Biomedical Advancements

In a groundbreaking development, an international team of scientists has engineered a flexible electrode, drawing inspiration from spider silk, that moulds around muscles, nerves, and hearts, demonstrating superior performance in electrical stimulation and signal recording compared to conventional stretchable electrodes.

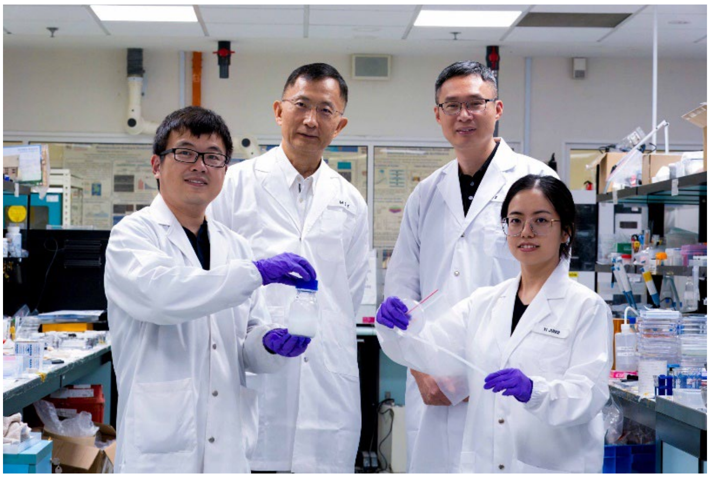

Image credits: Nanyang Technological University

This technological innovation has the potential to pave the way for biomedical devices, revolutionising areas such as irregular heartbeat monitoring, nerve repair, wound closure, and scar reduction.

The flexible electrode is crafted from a material that contracts when exposed to moisture, seamlessly fitting around tissues and organs. The material, formed into a thin film through repeated stretching, mimics spider silk’s intricate structure.

When dry, the film retains its stretched state due to the formation of bridges and pores in the semicrystalline PEO. Upon contact with water, the PEO structures dissolve, causing the material to contract, creating a snug fit around biological structures.

The researchers deposited electrically conductive gold onto the film before wetting it to create a flexible electrode. Rat experiments demonstrated the electrode's efficacy in delivering electrical impulses to nerves and recording signals from muscles, nerves, and the heart with higher sensitivity than conventional stretchable gold electrodes.

The electrode's water-responsive nature enables it to be wrapped around a rat heart, detecting abnormal heart rhythms without the need for customisation. Its minimally invasive installation procedure makes it suitable for temporary or permanent implantation, enhancing safety and simplicity.

Research fellow Dr Yi Junqi foresees water-responsive material as pivotal in future biomedical applications, while Prof. Chen Xiaodong and Prof. Gao Huajian emphasise the flexible electrode's potential in understanding brain disorders and treating neurodegenerative diseases by measuring delicate activities in living tissues.

In another breakthrough led by NTU Singapore, researchers have developed a cutting-edge method for treating glioblastoma, the most common form of brain cancer, using a significantly reduced dose of X-rays.

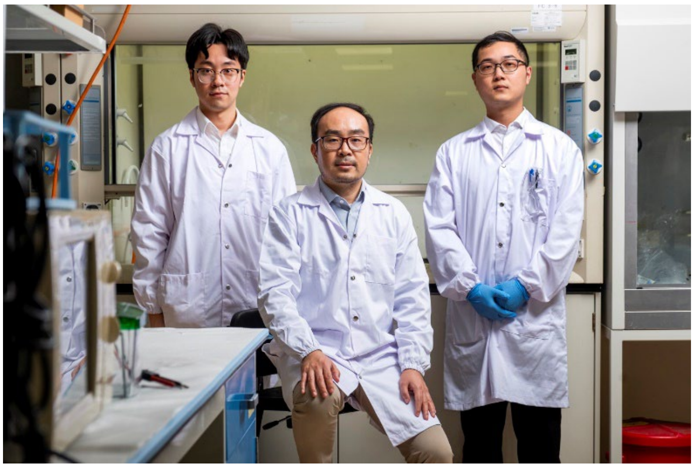

Image credits: Nanyang Technological University

This innovative radiodynamic therapy, utilising a novel compound known as a molecular radio afterglow dynamic probe (MRAP), demonstrates promising results in curbing brain tumour growth with minimal side effects, potentially revolutionising the landscape of brain cancer treatment.

Every year, over 300,000 people globally are diagnosed with glioblastoma, posing a significant challenge due to the limited effectiveness of conventional radiation treatments. Radiodynamic therapy, a promising alternative, involves specially made compounds activated by X-rays to create cancer-killing free radicals. However, the heavy metals in these compounds often cause unintended damage to healthy cells.

To overcome challenges in brain cancer treatment, Prof Pu Kanyi's team at NTU developed the MRAP compound, devoid of heavy metals, ensuring precise activation within brain tumour cells. In mouse experiments, MRAPs exhibited a remarkable response, absorbing X-ray radiation and releasing cancer-killing free radicals selectively in the presence of specific enzymes produced by brain tumour cells.

With a dosage significantly lower than conventional methods, MRAP treatment halted tumour growth in mice, showcasing a smart capability to selectively target tumour cells and minimise side effects in normal cells.

The MRAP technology offers a safer and more effective treatment method, showcasing potential advancements in brain cancer therapy. With a patent filed on MRAPs, discussions with potential investors are underway, indicating significant interest in advancing this groundbreaking research.

Looking ahead, Prof Pu's team aims to enhance MRAP's ability to target cancer cells further, incorporating immunotherapeutic functions to activate the immune system against cancer cells and combat cancer recurrence. The findings open new avenues for precise tumour cell elimination, presenting a promising future for brain cancer patients.

Professor Marc Vendrell from The University of Edinburgh highlights the importance of this research in advancing cancer treatments, suggesting that the next steps involve evaluating safety and efficacy in larger pre-clinical models and subsequent first-in-human studies.

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