Perspective
Volume 6:2, 2022

Research and Reports in Medical Sciences

ISSN: 2952-8127

Open Access

Interfacing Nanomaterial's-based Systems with Living Cells and Tissues

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Introduction

Nanotechnology enables the creation of devices small enough to allow single live cells to communicate, be monitored, and be stimulated. The advancement of understanding in nanostructure control allows them to be tailored to match cellular components, allowing for a high level of interfacing with single cells. In this context, recording and stimulating electrical impulses from electro genic cells and tissues is critical in a variety of fields, ranging from basic biophysical investigations of brain and heart function to medical monitoring and intervention. These investigations have mostly been carried out during the previous decades using a variety of well-established approaches that have substantially advanced the discipline but also posing technical limits. Using innovative nanotechnology-based techniques for extracellular and intracellular cellular electrical recordings. The study highlights the significant progress made in the development of minimally invasive experimental approaches for nanostructure-based electrophysiology that have the potential to be used in multiplexed measurements. These pioneering investigations revealed important issues [1-3].

Description

First, it was demonstrated that such devices may establish effective electrical communication routes with individual cells, resulting in signals that are substantially higher than those obtained with standard planar counterparts. The improved interaction between the Nano devices and the cell membranes may be the cause of these important findings. Second, the Nano scale devices' inherent better spatial resolution was used to create device-to-cell electrical connections at the level of individual neuritis. Third, large scale multiplexed real-time electrical recordings were facilitated by arrays of Nano devices, with the ultimate goal of signal mapping in brain and cardiac tissues. Nanomaterial-based electrical devices could potentially serve as true prosthetic devices in the future, depending on the aforementioned beneficial properties. The loss of tissue or organ function, whether due to trauma or disease, is linked to increased morbidity and death. Transplantation from one person to another is the acknowledged treatment for organ or tissue loss [4].

Unfortunately, the number of available donors vastly outnumbers the number of patients on the waiting list, resulting in high mortality rates. This circumstance prompted the creation of the 'tissue engineering' idea, in which 3-dimensional biomaterials act as extracellular matrix (ECM)-like scaffolds for living cells, allowing them to assemble into functional tissue substitutes that may restore tissue or organ function. The scaffolds either decay or metabolize after transplantation, leaving a viable tissue in place of the sick tissue. It is widely known that in order for cells to establish natural cell behavior and establish themselves, they must first establish themselves. In recent years, considerable efforts have been made to convert nanotechnology breakthroughs into medical practice, with diagnosis and therapy being the primary focus of these efforts. Because the sites for imaging and therapy are often the same, it became clear that the design of targeted nanomaterial's that can be imaged in vivo can also be used as a platform for delivering specific drugs to specific targets, resulting in materials for theranostics (therapeutics and diagnostics) applications. Nanomaterial's with high surface-to-volume ratios are not only good scaffolds for loading huge amounts of targeting moieties, imaging tags, and medicines, but they can also elicit therapeutic effects, making them the platform of choice for future integrated medical applications.

The article discusses recent advances in nanomaterial production and functionalization, as well as their use in the field of theranostics. Magnetic nanoparticles (MNPs), which were originally used as vascular contrast agents in magnetic resonance imaging (MRI), are an important class of nanomaterial's that have transformed into useful agents for targeted multimodal imaging and drug delivery systems over the last decade through carefully designed chemical functionalization. These groundbreaking discoveries laid the groundwork for transforming nanomaterial's into current and future theranostics platforms. The standard of care for cancer patients includes more than one therapeutic agent, resulting in complex therapies since many medications, administered via various routes, must be carefully coordinated, taking into account adverse effects and resistance mechanisms. DDS, such as polymers and liposomes, are meant to improve the pharmacokinetics and effectiveness of bioactive molecules (drugs, proteins, or oligonucleotides) while lowering systemic toxicity. DDS for co-delivery of many agents has a lot of promise since it targets synergistic therapeutic compounds at the same time, boosting their selective accumulation at the tumour site and amplifying their action, allowing for lesser doses of each agent and decreasing side effects [5]

Acknowledgement

We thank the anonymous reviewers for their constructive criticisms of the manuscript. The support from ROMA (Research Optimization and recovery in the Manufacturing industry), of the Research Council of Norway is highly appreciated by the authors.

Conflict of Interest

The Author declares there is no conflict of interest associated with this manuscript.

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Received: 04 March, 2022, Manuscript No. rrms-22-68064; **Editor assigned:** 05 March, 2022, Pre QC No. P-68064; **Reviewed:** 17 March, 2022, QC No. Q-68064; **Revised:** 21 March, 2022, Manuscript No. R-68064; **Published:** 29 March, 2022, DOI: 10.37421/-2952-8127.2022.06.74

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How to cite this article: Lagoon, Michel. “Interfacing Nanomaterial’s-based Systems with Living Cells and Tissues.” Res Rep Med Sci 6 (2022): 74.