Abstract for the General Public

Development of Perovskite Light Emitting Dressings for Accelerated Wound Healing

The benefits of utilizing perovskite nanocrystals (NCs) include its desirable photophysical attributes comprising tunable bandgaps, narrow emission, strong light-absorption coefficients, and high defect tolerance. These advantageous characteristics enable perovskite NCs to be used in various fields, such as solar cells and light-emitting diodes. Moreover, the use of perovskite NCs has been recently established in the biomedical research and the technological development of light-based therapy is the advanced process to repair wounds rapidly. Therefore, focus of the project is to synthesize of perovskite NCs and develop light-based treatments that have proven the effectiveness in enhancing various aspects of wound healing.

Reasons for attempting a particular research topic: When you go to sleep, your body goes into rest mode. Your internal clock, called a circadian rhythm, tells your body when to go to sleep and when to wake up. This cycle coincides with day and night, so that your body is programmed to be awake during the day and asleep during the night. This circadian rhythm also drives the active and rest phases of many of the processes of the cells in your body. It has also very recently been shown that circadian rhythms also impact wound healing, with wounds obtained at night taking twice as long to heal as comparable wounds obtained during the daylight, due to repair processes being less active at night. Wounds which take longer to heal are at increased risk of infection and are potentially much more dangerous to patients than those which heal effectively.

The project goal: the **scientific goal of this project is to synthesize of highly air-stable, single crystalline, mono-dispersed, phase-pure halide perovskite [$CsPbX_3$ (X = Cl, Br, I)] NCs by a modified hot-injection method.** Then utilizing the intense emission, high color purity and color tunability of all-inorganic halide perovskite NCs, the principal investigator (PI) will fabricate and develop a **perovskite-based light emitting electrochemical cells (PeLECs)** on a flexible platform. Finally, the flexible PeLECs will be implemented as a light-based treatment that have shown tremendous effectiveness in enhancing various aspects of **faster wound healing process**.

Description of research: This project will divide into 5 work packages (WPs): (1) synthesize of stable halide perovskite NCs, (2) fabrication of PeLECs using different electron and hole transport layers, (3) development of PeLECs prototype on a flexible PET substrate, (4) optimization and incorporation of PeLECs prototype within a wound dressing, and (5) evaluation of the impact of mechanical deformation on the PeLECs wound dressing. At the begging of the project, PI will synthesize perovskite NCs by modified hot-injection method. In the modified hot-injection method, toxic 1-octadecene will be ruled out and instead different types commercial products of olive oil will be used as a solvent as well as a solubilising agent for both Cs and Pb. A passivation process of the halide perovskite NCs will enhance the air stability by using a functional ligand (1-dodecanethiol or 1-octadecanethiol) and B-site doping (Cu^{++} doping). Finally, project will develop a PeLECs, which will emit different color of light (red, green and blue), activating the circadian regulated components of fibroblasts in the wound-healing response.

Substantial results expected: The proposed research should allow the synthesize an air-stable, single crystalline, mono-dispersed, phase-pure halide perovskite NCs by a modified hot-injection method. The atomic resolution transmission electron microscopy, Rietveld refinement, optical characterizations and theoretical calculations will allow to make stable perovskite NCs in solution as well as the films in ambient conditions. With the tailored property in terms of atomic structure, high luminescence intensity, fabrication of PeLECs devices and its application in wound healing, results would be summarized in the form of paper work. The papers would be submitted in the reputed and high impact international journal and presented in several international conferences. In order to develop such kind of perovskite NCs synthesize and fabrication of PeLECs for wound healing deep research are needed. The PI can achieve the targeted goal and gain experience working with highly expert group in Poland. Therefore, chosen problems are very important and common as well as specific uses for the society.