BioPoweredCL - Bright and biologically powered chemiluminescent labels for cell and tissue imaging

Imaging is one of the most powerful technique to visualize molecules, tissues, to understand and follow processes and it is the most used diagnostic tool in vitro and in vivo, Current biomedical imaging techniques can have high sensitivity, good spatial/temporal resolution and, in some cases, high tissue penetration but cannot combine all of these desired properties without using harmful radiations (or toxic labels) or very expensive equipment. Optical imaging techniques represent the best compromise among them; however, their ability to scale to human body is precluded. The main restriction of fluorescence imaging is that it requires light excitation which is limited by tissue absorption and scattering. Such limitations are not present in chemiluminescence imaging since light production occurs through a chemical reaction, resulting in higher penetration depth and best sensitivity. However both natural and artificial chemiluminescent systems require a continuous flow of exogenous reactants since all substrates are irreversibly consumed. BioPoweredCL aims to develop an unprecedented strategy to enable molecular imaging by realizing near infrared luminophores that harvest energy from the cellular respiration chain, in order to emit light without being consumed themselves. BioPoweredCL takes advantage of the most recent progress in artificial light production to develop a novel imaging technique where the absence of an excitation source overcomes the current limitations of fluorescence imaging while the regeneration of the luminophore overcomes the limitations of bioluminescence imaging. If successful it could replace current techniques based on harmful ionizing radiations such as X-rays or γ-rays. To reach such a grand-challenge the work plan is articulated into three different phases: 1) synthesis of new luminophores; 2) electrochemical characterization and energy cell harvesting; 3) in vitro experiments where the full potential of the approach will be validated.

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Department: Chemical Sciences

Coordinator: Università degli Studi di Padova

Total EU Contribution: Euro 1.449.750,00

Call ID: ERC- 2020- StG

Project Duration in months: 60

Start Date: 01/10/2021

End Date: 30/09/2026

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