
Bioluminescence in Bionanotechnology and Translational Medicine

Sylvia Daunert*¹

¹Department of Biochemistry and Molecular Biology, Miller School of Medicine, University of Miami (UM) – Dr. Sylvia Daunert Professor and Lucille P. Markey Chair Associate Director, Dr. JT Macdonald Biomedical Nanotechnology Institute Department of Biochemistry and Molecular Biology R. Bunn Gautier Bldg. 1011 NW 15th Street Miller School of Medicine University of Miami Miami, FL 33136, United States

Abstract

Bioluminescence is a relatively rare phenomenon in nature that has found important applications in science and technology. The intrinsic sensitivity and low detection limits of bioluminescence have allowed for its use in the design and development of multiple state-of-the-art detection platforms and technologies. Thus, bioluminescence has emerged as a powerful tool for detection of biomolecules at the molecular and cellular level. Bionanotechnology has spurred the creation of biologically inspired "designer" molecules capable of performing sophisticated tasks at the nanoscale. Nature produces highly complex molecules and materials that are manufactured in macromolecular factories located within the cell. All of these processes have a molecular recognition component, which provides them with exquisite selectivity and, often, unusual sensitivity. Inspired by these events, our research group takes advantage of both, bioluminescence and natural processes to engineer and develop new bionanotechnology methods, devices, and tools based on genetically engineered proteins and cells for laboratory, point-of-care, and field applications. Specifically, we prepare nanoscale biosensors, and molecular diagnostic tools striving to simplify the methodologies employed and make them amenable for use even in remote locations where there are no resources and no access to laboratories and/or equipment. The developed bionanotechnologies find applications in the environmental and pharmaceutical fields, as well as in translational medicine by focusing on the creation of targeted and responsive nanocarrier-based imaging for real-time visualization of biological processes within living organisms. In that regard, we have recently demonstrated the feasibility and efficacy of these techniques in two major fields of oncology research, namely, detection of circulating tumor cells, and image-guided therapy.

Keywords: bionanotechnology, bioluminescence, imaging, biosensing, molecular diagnostics, targeted delivery

*Speaker