Bioluminescence-based bioanalytical tools

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Bioluminescence (BL), that is the emission of cold light in living organisms, is a well-established optical detection technique explored and widely applied in several bioanalytical applications. BL provided a formidable manifold system relying on different luciferases and luciferin analogues with a wide range of applications spanning from molecular imaging to biosensing. It is highly attractive thanks to its intrinsic high-signal-to-noise ratio, high dynamic range, equipment simplicity, suitability to multiplexing. The availability of new BL proteins with tuned properties, both in terms of emission wavelength, kinetics and protein stability, is highly valuable in the bioanalytical field, with the potential to improve the sensitivity and analytical performance of the currently used methods for ATP detection, whole-cell biosensors, and viability assays among others [1-4].
Thanks to reporter gene technology a BL reporter protein can be expressed under the regulation of a target promoter sequence or enhancer elements, thus enabling correlation of reporter protein expression, measured as light signal, and transcriptional regulation. The BL reporter protein can be splitted into two halves for studying protein-protein interactions, exploiting the cDNA encoding for these fragments genetically fused to the two proteins which interaction is under investigation.
The ability to emit photons without the need of photoexcitation renders BL a suitable alternative to the more widespread fluorescence, and highly appealing for the implementation into portable and miniaturized devices. The unprecedented technological evolution of portable light detectors opened new possibilities to implement bioluminescence detection into miniaturized devices [3,5-7]. A portfolio of cell-based BL biosensors and cell-free systems will be presented with a look at the current challenges and the different strategies used to convert current laboratory methods into portable biosensors.

References

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