Engineering molecular switches for glow-in-the-dark diagnostics

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Immunoassays and quantitative PCR form the cornerstones of today`s clinical biomolecular diagnostics. Their success is rooted in their modularity and the possibility to develop assays against almost any molecular target. However, translation of traditional heterogeneous immunoassays and PCR into point-of-care (POC) assays has proven challenging, because both require multiple, time-consuming incubation and washing steps, the addition of exogenous reagents, and external calibration. Laminar flow immune assays (LFIAs) have been introduced as cheap and relatively easy-to-use POC immunoassays, but they suffer from limited sensitivity and are primarily used as qualitative tests.

In recent years our group pioneered the development of bioluminescent sensor proteins that allow affinity-based detection of antibodies, proteins, small molecules, and DNA/RNA directly in complex samples using the camera of a smart phone as the sole piece of equipment. Unlike fluorescence, whose dependence on external illumination gives rise to autofluorescence and scattering, bioluminescence is ideally suited to measure analytes directly in complex media such as blood plasma with minimal sample handling. In my lecture I'll present several glow-in-the-dark diagnostic formats recently developed in our group as alternatives for sandwich immunoassays (RAPPID)[1-3], and competition-based immunoassays (LUCOS)[4], and qPCR using bioluminescent intercalating dyes (LUMID)[5] and CRISPR-Cas9-mediated detection of dsDNA (LUNAS)[6]. These homogeneous ratiometric bioluminescent assay platforms are attractive for POC applications as they can be easily integrated in cheap and simple paper- or thread-based analytical devices or integrated into microfluidic cartridges that require minimal sample handling.

References:

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