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Photoelectrochemical systems for biochemical detection

Abstract: Photobioelectrochemical systems have become an interesting new research field with applications in biosensing, bioenergetics and biocatalysis. Here light-sensitive elements are coupled with biocatalytic reactions for the generation of photocutrrents. The light sensitive element can consist of semiconductor materials or their combinations but can also comprise photoactive proteins. Significan progress has been achieved within this research fiel, however limitations can occur because of small sensor signals, a limited number of analytes and also in applications for which a close contact of the sensing surface with biological systems such as a cell culture is essential.
Different approaches have been developd in order to address these bottlenecks. For example, semiconductor nanostructures such as quantum dots (QDs) can be replaced by InGaN nanowires. This allows direct detection of analytes, but also combinations with enzymes.

Recently we have combined a second semiconductor material TiO_2 with quantum dots. This high band gap material is not excited by visible light, but improves charge carrier sepration within the QDs. Such systems result in significantly improved photocurrent signals, but also in enhanced signals when analyte molecules such as hydrogen peroxide are converted. Furthermore, it is demonstrated that living celles can be cultivated on top of such a sensing platform without impacting viability.
These studies may illustrate that advantages of photoelectrochemical sensing systems can be combined with enhanced analytical performances such as increased sensitivity and stability - and therefore, resulting in an improved applicability.

Keywords: semiconductor nanostructures, enzymes, photocurrent generation, cell culure measurements, combination of two light sensitive systems.

Biography:
Fred Lisdat studied chemistry at Humboldt University and got phd in 1992. Research interest moved from chemical sensors towards biosensors. 1994 he joined the research group of Prof. Scheller at Potsdam University. He finalised habilitation in 2004. 2001 he was working as guest professor at Tokyo University. 2004 he got the Professorship of Biosystems Technology at Technical University Wildau. He has been active in several national and international organisations, e.g. as chair of division 2 of International Society of Electrochemistry, board of biosensor division of the GdCh, head group of sensor section of Dechema or president of the Bioelectrochemical Society. 2024 he got the Bioelectrochemistry Prize of ISE.