Universität Basel

Research Project

Sustainable nanoscale and materials chemistry

Third-party funded project

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One of the major challenges facing mankind in the next Century is the transition from fossil fuels as the primary energy source to alternative generation methods. In addition there is a demand for more efficient usage of existing energy sources. Materials and nanoscale science have made enormous advances in developing, at least to the proof-of-principle stage, technologies that can address the scientific issues. Unfortunately, many of the emerging technologies are based upon elements which are scarce, rendering the long-term sustainability questionable. This proposal concerns a variety of sub-projects related to the development of (i) energy efficient lighting devices (LECs) based on iridium or earth abundant metals (ii) sustainable dye-sensitized solar cells (DSCs) based on copper and (iii) functionalised interfaces. Light-emitting electrochemical cells (LECs) are simple and cost-effective devices related to OLEDs. State-of-the-art devices use iridium complexes. We are developing new complexes for long-lived LECs using strategies based on variation of ligand structure to tune the emission maxima. The complexes will incorporate the features we have already shown to lead to long-lived devices. We will also investigate the use of copper(I) and zinc(II) complexes incorporating bidentate diimines and bidentate soft PP, PS and SS donors. To date, there have only been very few examples of LECs based on first row transition metals. We will further develop a high throughput method of testing luminescent compounds for use in LECs. We recently described the first examples of efficient DSCs using copper(I) complexes as sensitizers. Following this first result we have worked on improving the efficiencies of these devices. We are now further increasing our effort in designing complexes for copper(I)-DSCs to maintain our world-leading position. We have recently prepared DSCs with efficiencies of the order of 7%. We will also develop exchange reactions for the construction of optimized DSCs and DSCs with libraries of complexes, avoiding the need to design ”black” dyes. Finally, we will extend our studies on photocatalytic systems for the oxidation of water to heterogeneous systems and possibly to tandem cells. In particular, we will use functional multilayers prepared from Langmuir Blodgett films of cationic, photoactive luminescent complexes on aqueous sub-layers of polyoxometallate clusters (the water oxidation catalysts).

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