SYEC 3: Photonics-Assisted Green Energy Production I

Time: Tuesday 15:30–16:00 Location: ELP 6: HS 4

SYEC 3.1 Tue 15:30 ELP 6: HS 4

Upconversion Nanoparticles Towards Sensing in Hydrogen Electrolysis Cells — •Rajesh Komban[1], Simon Spelthann[2], Lea Kötters[2], Michael Steinke[2,3], and Christoph Gimmler[1] — [1]Fraunhofer Center for Applied Nanotechnology CAN, D-20146 Hamburg, Germany — [2]Institute of Quantum Optics, Leibniz University Hannover, D-30167 Hannover, Germany — [3]QUEST-Leibniz-Research School, Leibniz University Hannover, D-30167 Hannover, Germany

With its potential to address environmental concerns and energy security, hydrogen is gaining prominence in various energy sectors. In this scenario, the proton exchange membrane (PEM) electrolysis cell emerges as a significant tool for generating green hydrogen from water. The temperature inside these cells is crucial, as it directly correlates with their efficiency. To monitor the temperature in situ, a specialized technique needs to be developed.

The utilization of luminescent intensity ratio-based thermometry coupled with a fiber sensor would be an optimal choice for such an application. As lanthanide ions excited energy levels enable such correlation, we develop lanthanide doped green emitting upconversion nanoparticles (UCNP) for this purpose. Highly efficient submicron range $NaYF_4$:Er^{3+},Yb^{3+} UCNP core particles are developed and further modified their surface with silicon dioxide shell to enable them to stick on surface of the fiber. We assume that these functionalized UCNP can be used in different fiber based temperature sensors not only in PEM cells, but also in battery technology.

SYEC 3.2 Tue 15:45 ELP 6: HS 4

Nanothermometers on Fiber Tip for Temperature Measurements in Water Electrolysis Cells — •Lea Koetters[1], Simon Spelthann[1], Lena Bühre[2], Mareike Benecke[2], Rajesh Komban[3], Patrick Späth[4], Wiebke Albrecht[4], Boris Bensmann[2], Christoph Gimmler[3], Richard Hanke-Rauschenbach[2], and Michael Steinke[1] — [1]Leibniz University Hannover, Institute of Quantum Optics, Hannover, Germany — [2]Leibniz University Hannover, Institute for Electric Power Systems, Hannover, Germany — [3]Fraunhofer-Institut für Angewandte Polymerforschung IAP, Hamburg, Germany — [4]AMOLF, Amsterdam, Netherlands

Hydrogen from Proton Exchange Membrane Water Electrolysis (PEMWE) cells enables the storage of sustainably generated energy. The efficiency and longevity of these cells depend on operating conditions such as the temperature of the membrane. We set up a fiber sensor using lanthanide-doped nanoparticles as nanothermometers and employed it to measure the temperature at the cell's membrane for different operational conditions. The results will help us to optimize the cell's operational parameters. The sensor is also applicable in strong electromagnetic fields, for example in battery technology or magnetic resonance tomography.