# From Hydrogen Detection to Energy Harvesting: Advances in Self-Sustaining Sensing Technologies from a Materials perspective

**Rainer Adelung**[1]

[1] Chair for functional nanomaterials, Kiel University, Germany, ra@tf.uni-kiel.de, ORCID: 0000-0002-2617-678X , https://www.tf.uni-kiel.de/matwis/fnano/de/Members/prof.-dr.-rer.-nat.-rainer-adelung

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**Abstract.** The integration of energy supply with sensing technologies is enabling a new generation of autonomous sensors that address challenges in environmental, biomedical, and industrial applications. Recent basic research ideas in self-powered sensors are highlighted, focusing on innovative material systems and energy harvesting strategies that combine detection ideas for sustainable energy systems like fuel cells, electrical systems or living matter.

Ultra-selective hydrogen detection is achieved through core-shell structures featuring tetrapodal zinc oxide (t-ZnO) with a crystalline copper oxide (CuO) coating, which enhances sensitivity at low operational temperatures [1]. This advanced heterostructure demonstrates how surface engineering can improve sensor performance, particularly for environmental monitoring applications.

Building on these innovations, multifunctional t-ZnO-based sensors capable of detecting ultraviolet radiation and volatile organic compounds (VOCs) exhibit robust response and recovery characteristics over a wide temperature range [2]. Such versatility positions these sensors as promising solutions for biomedical applications where multifunctional sensing is crucial. Further extending the scope of functional materials, hybrid $CsPbBr_3/SiO_2$ aero-frameworks are presented for efficient light conversion and thermal management in high-intensity laser illumination systems [3]. These functional light diffusers enable uniform light distribution and improved thermal stability,

providing a pathway for integrating light detection and conversion functionalities e.g. for gas sensor technology, see Fig.1.

In addition, self-powered magnetoelectric sensors utilize resonant cantilevers and permanent magnets for magnetic field detection without the need for external power supplies [4]. This approach not only facilitates highly sensitive magnetic field detection for biomedical applications but also enables efficient energy harvesting from ambient magnetic fields.

These advancements demonstrate the synergy between material innovation and energy systems detection and autonomy, offering a pathway to versatile, sensing technologies that meet the needs of future smart systems.

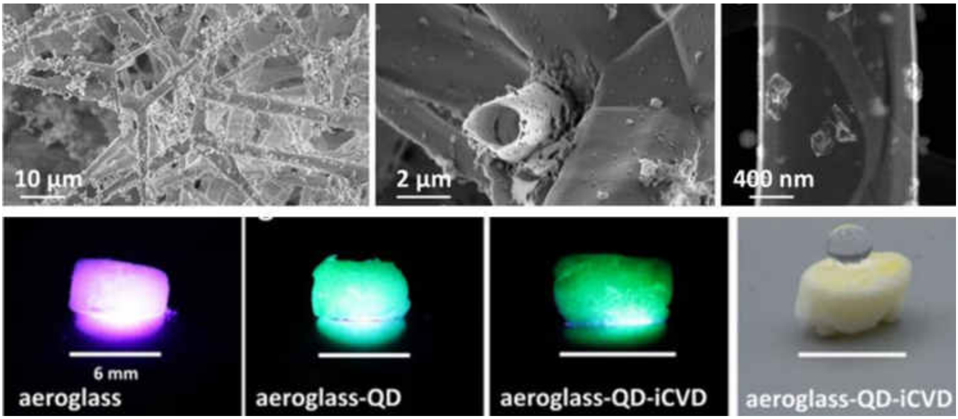


Fig.1. SEM images and photographs of qd-functionalized aeroglass, from [3]

**References**

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