Photons in the Environmental Transmission Electron Microscope

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Publication date:
2013

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Efficient harvesting of solar energy is the only technology that has the potential of eventually supplying the entire population of the Earth with sufficient energy in a sustainable way as a stand-alone, long-term solution. Covering 0.1% of the surface of the planet with a device that converts solar energy into a useable form at 10% efficiency would give more than the present worldwide consumption of fossil energy. Photocatalysts are of fundamental interest as they provide a viable route for converting solar energy into chemical bonds. By means of Transmission Electron Microscopy (TEM) it is possible to gain insight in the fundamentals of their reaction mechanisms, chemical behavior, structure and morphology before, during and after reaction using *in situ* investigations.

Typically, photocatalysts work in gaseous or liquid atmosphere under light illumination. Here, the aim is to reproduce their working conditions *in situ*. The Environmental TEM (*1*) allows exposing specimens to a controlled gas atmosphere, thus implementation of *in situ* sample illumination is needed. Two specimen holders capable of exposing samples to light inside the TEM were designed and constructed (*2*). The holders were used to characterize photoactive materials in a simulated working environment and employed in the analysis of various photoreactive materials and structures. Novel information on the behavior of such materials during reaction was acquired in a reproducible fashion. In a wider perspective, the aim is to build a versatile experimental platform inside the microscope that allows electron microscopy under nonconventional TEM conditions and new kinds of *in situ* spectroscopy.

1. T. W. Hansen, J. B. Wagner, R. E. Dunin-Borkowski, Aberration corrected and monochromated environmental transmission electron microscopy: challenges and prospects for materials science. *Mater. Sci. Technol.* **26**, 1338 (2010).
2. F. Cavalca *et al.*, In situ transmission electron microscopy of light-induced photocatalytic reactions. *Nanotechnology* **23**, (Feb, 2012).