



Transmission electron microscopy characterization of photocatalysts for water splitting

Cavalca, Filippo; Laursen, Anders Bo; Dahl, Søren; Kardynal, Beata; Dunin-Borkowski, Rafal E.; Wagner, Jakob Birkedal; Hansen, Thomas Willum

Publication date:
2012

[Link back to DTU Orbit](#)

Citation (APA):

Cavalca, F., Laursen, A. B., Dahl, S., Kardynal, B., Dunin-Borkowski, R. E., Wagner, J. B., & Hansen, T. W. (2012). *Transmission electron microscopy characterization of photocatalysts for water splitting*. Abstract from 2nd International Symposium on Advanced Electron Microscopy for Catalysis and Energy Storage Materials, Berlin, Germany.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Transmission electron microscopy characterization of photocatalysts for water splitting

Filippo Cavalca^{1,*}, Anders B. Laursen², Søren Dahl², Beata E. Kardynał³, Rafal E. Dunin-Borkowski^{1,4}, Jakob B. Wagner¹, Thomas W. Hansen¹

¹ Center for Electron Nanoscopy, Technical University of Denmark, DK-2800 Kgs. Lyngby, Denmark

² Center for Individual Nanoparticle Functionality, Technical University of Denmark, DK-2800 Kgs. Lyngby, Denmark

³ Department of Photonics Engineering, Technical University of Denmark, DK-2800 Kgs. Lyngby, Denmark

⁴ Ernst Ruska–Centre for Microscopy and Spectroscopy with Electrons (ER-C) and Peter Grünberg Institute (PGI), Forschungszentrum Jülich, D-52425 Jülich, Germany

*: presenting author, email: Filippo.cavalca@cen.dtu.dk

Abstract

As a result of diminishing fossil fuel reserves, there is an increasing need to switch energy dependence to renewable resources such as sunlight. Photocatalysts provide a viable route for converting solar energy into chemical bonds. In order to optimize the performance of such materials, it is necessary to understand the fundamentals of their reaction mechanisms, chemical behavior, structure and morphology before, during and after reaction using *in situ* investigations. Here, we focus on the *in situ* characterization of photocatalysts [1] in an environmental transmission electron microscope (ETEM) [2]. Such fundamental insight can be used for further material optimization with respect to performance and stability [3].

In this work, we combine conventional TEM analysis of photocatalysts with environmental TEM (ETEM) and photoactivation using light. A novel type of TEM specimen holder that enables *in situ* illumination is developed to study light-induced phenomena in photoactive materials at the nanoscale under working conditions.

Our experiments are aimed at exposing a specimen to light and detecting resulting microstructural and chemical changes using *in situ* TEM techniques. It is important to investigate photoactive materials under light illumination in order to remove the effects associated with handling of the specimen between *ex situ* reactions and TEM experiments. Two representative photoinduced phenomena are studied: the photodegradation of Cu₂O and the photodeposition of Pt onto a GaN:ZnO photocatalyst (Figure 1).

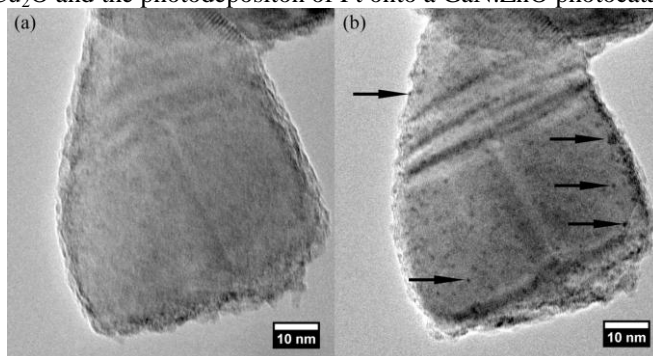


Figure 1: (a,b) Bright field TEM images of a GaN:ZnO particle (a) before and (b) after reaction in 5 mbar H₂O and with 6 W cm⁻² light at 405nm wavelength.

References

- 1) Herrmann J-M 2005 Topics in Catalysis 34 49-65.
- 2) Gai PL 2003 ChemInform 34 161-173.
- 3) Tsujimoto M, Moriguchi S, Isoda S, Kobayashi T and Komatsu T 1999 Journal of Electron Microscopy 48 361-366.
- 4) Hansen TW, Wagner JB and Dunin-Borkowski RE 2010 Materials Science and Technology 26 1338-1344.