ITFPC17 8TH INTERNATIONAL CONFERENCE ON INNOVATIONS IN THIN FILM PROCESSING AND CHARACTERIZATION
23-27 October 2017 NANCY, FRANCE

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Atomic layer deposition for photovoltaics - ALD4PV

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Atomic layer deposition (ALD) has become a very important technique, especially in the semiconductor industry as it enables film properties and process conditions which cannot be achieved by other techniques. ALD is a CVD-like deposition method in which precursors are injected into the reactor chamber alternately and in which the reactions are driven by the surface chemistry and not by thermal decomposition. The so-obtained self-limiting growth behavior allows for the deposition of uniform, ultrathin films with Ångstrom-level resolution and with a high conformality on demanding 3D surface topologies.

In recent years, it has been realized that the unique features of atomic layer deposition (ALD) can also be employed to face processing challenges for various types of solar cells. With this, ALD for photovoltaics (ALD4PV) has attracted great interest in academic and industrial research and it has even been introduced in high-volume manufacturing.

In this presentation, the status of the use of ALD nanolayers in various solar cell technologies will be reviewed and their future prospects will be discussed [1]. The presentation will focus particularly on (i) the application of ALD oxides, most prominently Al2O3, for the passivation of surfaces of high-efficiency silicon solar cells [2]; (ii) the preparation of highly transparent conductive oxides (doped ZnO films and In2O3:H); and (iii) the use of ALD-prepared nanolayers in perovskite solar cells [3]. Also the upscaling of ALD to high-throughput solar cell production will be addressed [4].

[1] *Atomic layer deposition for photovoltaics: Applications and prospects for solar cell manufacturing*, J.A. van Delft, D. Garcia-Alonso, and W.M.M. Kessels, Semicond. Sci. Technol. 27, 074002 (2012).

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[3] *Advanced Process Technologies: Plasma, Direct-Write, Atmospheric, and Roll-to-Roll ALD,* W.M.M. Kessels and M. Putkonen, MRS Bulletin 36, 907 (2011).

[4] *Atomic layer deposition for perovskite solar cells: research status, opportunities and challenges,* V. Zardetto, B. L. Williams, A. Perrotta, F. Di Giacomo, M. A. Verheijen, R. Andriessen, W. M. M. Kessels and M. Creatore, Sustainable Energy Fuels 1, 30 (2017)

SHORT BIO

Erwin Kessels is a full professor at the Department of Applied Physics of the Eindhoven University of Technology TU/e (The Netherlands). He is also the scientific director of the NanoLab@TU/e facilities which provides clean room infrastructure for R&D in nanotechnology. Erwin received his M.Sc. and Ph.D. degree (with highest honors) in Applied Physics from the TU/e in 1996 and 2000, respectively. After obtaining international experience at the University of California Santa Barbara, Colorado State University and Philipps University in Marburg, he was appointed as assistant professor at the TU/e in 2002. He was promoted to full professor in 2011. His research interests cover the field of synthesis of ultrathin films and nanostructures using methods such as (plasma-enhanced) chemical vapor deposition (CVD) and atomic layer deposition (ALD) for a wide variety of applications, mostly within the areas of nanoelectronics and photovoltaics. Within the field of ALD, he has contributed most prominently by his work on plasma-assisted ALD and his research related to ALD for photovoltaics. Erwin chaired the International Conference on Atomic Layer Deposition in 2008, has won several awards (including the Peter Mark Memorial Award from the American Vacuum Society) and he has published over 250 papers and holds 2 patents.