# 02054
# The role of Frenkel pair defects and atomic layer deposited alumina on the perovskite solar cells' stability

## B. Materials for energy conversion systems: fundamentals, designs, and applications

**Małgorzata Kot** [1]

[1]**Btu Cottbus-Senftenberg - Cottbus (Germany)**

**Abstract**

Rather still poor long-term stability of the perovskite solar cells (PSCs) is the major factor limiting their mass production. In this work, I will show that the efficiency decrease of PSCs originates from the creation of Frenkel pair defects (MA+ and I- interstitials) in the perovskite film under illumination, and their movement across the solar cell.[1-2] The stronger the illumination, the higher the number of created Frenkel defects and their release from the perovskite absorber, leading to a faster efficiency decline and more substantial hysteresis in the j-V sweeps. However, once the perovskite film is covered by few cycles of atomic layer deposited (ALD) alumina[3-4], even at room temperature, it helps to self-heal the partially degraded perovskite film by successively blocking the flow of such ions across the charge transporting layers. This fact could also explain observation why the ALD-coated perovskite solar cell does not show negligible hysteresis after long-term operations. Moreover, the ALD/perovskite-based PSCs show an increase of the initial efficiency over time, while it significantly decreases in the bare perovskite-based PSCs [6]. Therefore, the ALD process of TMA and water on perovskite may be an extremely simple, fast and inexpensive way to overcome the long-term stability issue of PSCs and bring them to the market.

[1] M. Kot, L. Kegelmann, H. Köbler, M. Vorokhta, C. Escudero, P. Kúš, B. Šmíd, M. Tallarida, S. Albrecht, A. Abate, I. Matolínová, D. Schmeißer and J. I. Flege, ChemSusChem, 2020, 13(21), 5722-5730.
[2] C. Das, M. Kot, T. Hellmann, C. Wittich, E. Mankel and I. Zimmermann, Cell Reports Physical Science, 2020, 1(7), 100112.
[3] M. Kot, C. Das, Z. Wang, K. Henkel, Z. Rouissi, K. Wojciechowski, H. J. Snaith and D. Schmeisser, ChemSusChem, 2016, 9, 3401.
[4] M. Sowinska, C. Das, K. Wojciechowski , Z. Rouissi , H. J. Snaith and D. Schmeisser, Synchrotron Radiation in Natural Science, 2016, 15, 33.

[5] M. Kot, C. Das, K. Henkel, K. Wojciechowski, H. J. Snaith and D. Schmeisser, Nucl. Instrum. Methods Phys. Res., Sect. B, 2017, 411, 49-52
[6] M. Kot, L. Kegelmann, C. Das, P. Kus, N. Tsud, I. Matolinova, S. Albrecht, V. Matolin and D. Schmeisser, ChemSusChem, 2018, 11, 3640.
[7] K. Henkel, M. Kot, M. Richter, M. Tallarida and D. Schmeißer, in Encyclopedia of Interfacial Chemistry: Surface Science and Electrochemistry, edited by K. Wandelt (Elsevier, Oxford, 2018), Vol. 3.1, pp. 18–26.
[8] D. Schmeißer, M. Kot, S. Alberton Corrêa, C. Das and K. Henkel, in Encyclopedia of Interfacial Chemistry: Surface Science and Electrochemistry, edited by K. Wandelt (Elsevier, Oxford, 2018), Vol. 3.1, pp. 162–171.
[9] K. Henkel, M. Kot and D. Schmeißer, J. Vac. Sci. Technol. A, 2019, 35(1), 01B125-1.