

Application of the ALD method in ZnO/GaAs solar cells fabrication

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n-ZnO / p-GaAs

Irrespective of the growth method, ZnO always gains its native „n-type” conductivity. In this work, the ALD (Atomic Layer Deposition) method was applied to deposit n-ZnO and n⁺-AZO (Aluminum-doped Zinc Oxide) layers on the p-GaAs substrates. The experiment was conducted in order to obtain the AZO/ZnO/p-GaAs and AZO/p-GaAs solar cell structures. It was also performed to verify the AZO and ZnO applicability both as TCO (Transparent Conductive Oxide) and n⁺/n-type partners for the underlying p-GaAs substrates. The following process/material parameters were applied in the experiment:

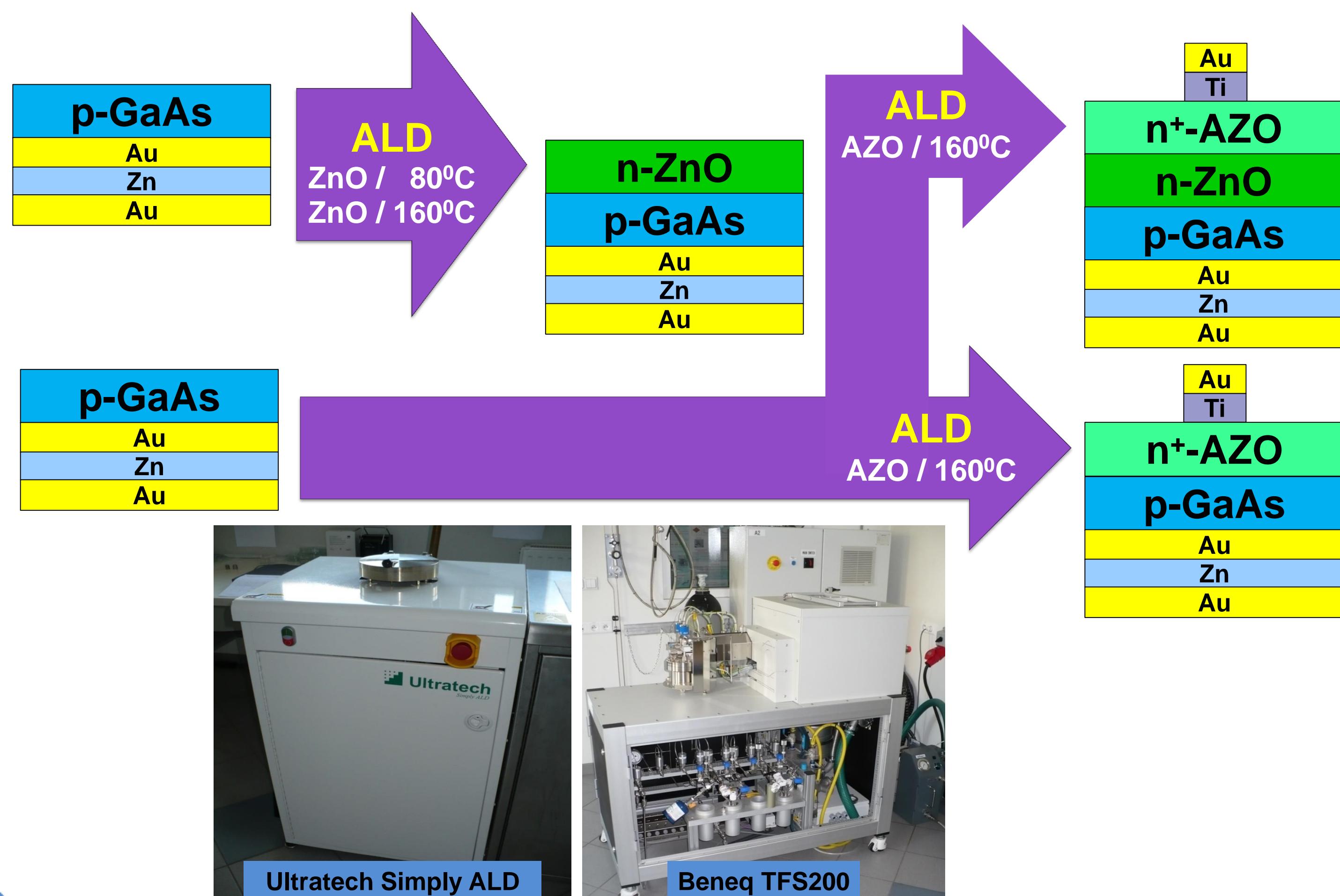
- 3 levels of Zn doping of the p-GaAs:Zn : 5×10^{16} , 3×10^{17} , 8.6×10^{16} [cm⁻³]
- 3 temperatures of ZnO /AZO deposition : 80, 160 /160 [°C]
- 2 types of photovoltaic structures : AZO/ZnO/p-GaAs and AZO/p-GaAs

p-ZnO / n-GaAs

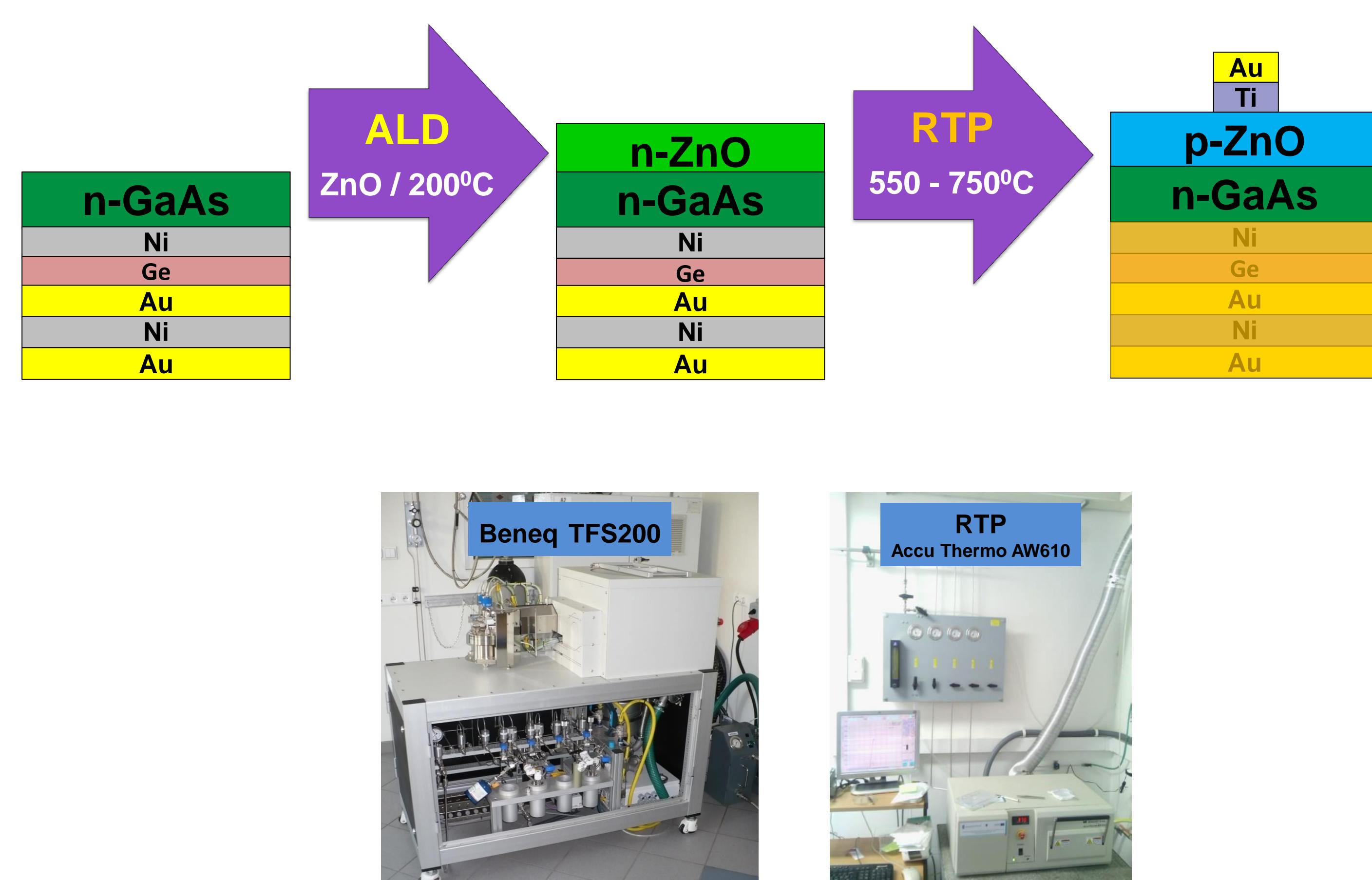
ZnO of the „p-type” can be obtained when doped with e.g.: P, As, N, Sb elements. It is proved that ZnO:As, in particular, can be made by arsenic thermal diffusion from the GaAs substrate [1,2,3]. In such case, it is believed, that p-type conductivity results from the formation of As_{Zn}-2V_{Zn} complexes acting as shallow acceptors [4]. In the experiment, we took advantage of this phenomenon by applying RTP (Rapid Thermal Processing) on the n-ZnO/n-GaAs structures, fabricated by the ALD method, in order to obtain p-ZnO/n-GaAs solar cell devices. The test was also conducted to verify the applicability of the p-ZnO as TCO and p-type partner for the n-GaAs base. The following process/material parameters were applied in the experiment:

- 2 types/levels of n-GaAs substrates/doping:
GaAs: $5.2-6.7 \times 10^{15}$ [cm⁻³]; GaAs:Te: $0.5-2.3 \times 10^{17}$ [cm⁻³]
- 5 levels of RTP annealing temperatures: 550, 600, 650, 700 and 750 [°C]

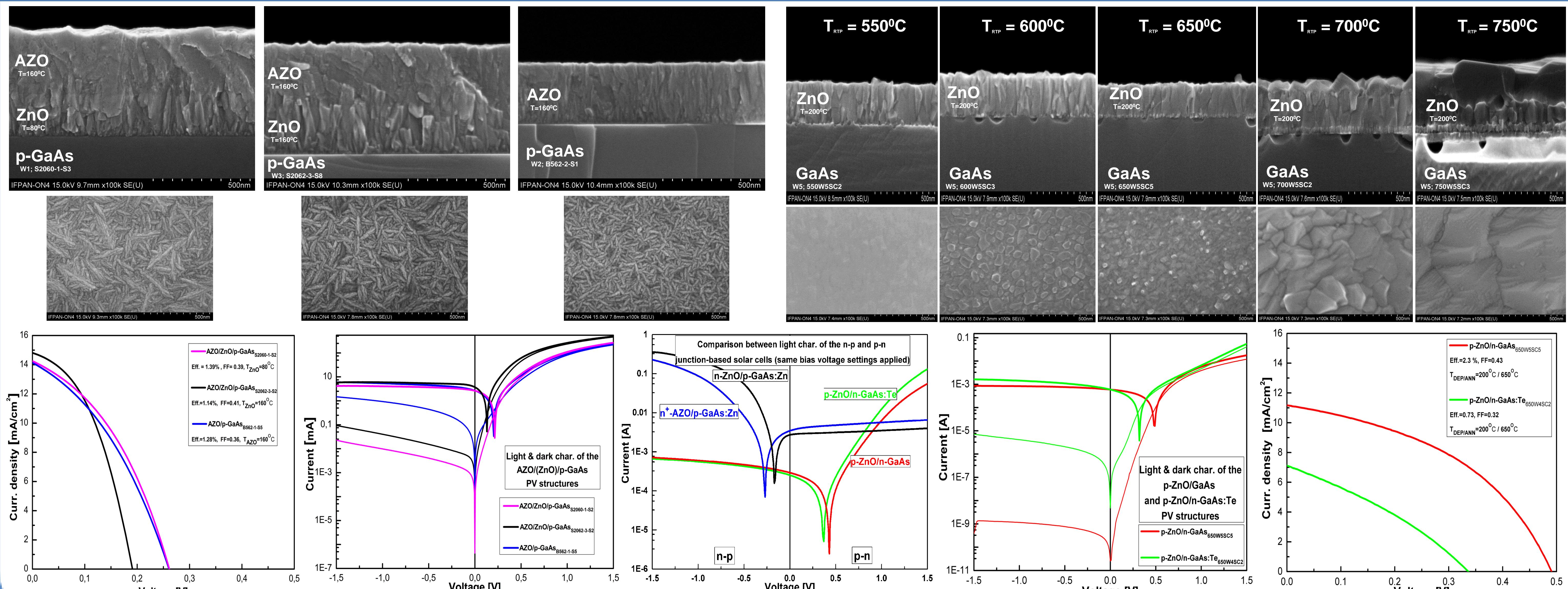
ALD



ALD & RTP



Results



References

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Acknowledgements

This work was partially supported by the Polish National Science Centre (NCN) (DEC-2012/06/A/ST7/00398; DEC-2013/11/B/ST7/01385) and (Wrocław group) by the National Laboratory of Quantum Technologies (POIG.02.02.00-00-003/08-00) and Statutory grant S400291.