

# Influence of deciding/synthesis parameters of hydrothermally grown ZnO nanowires for FTO - free perovskite solar cells

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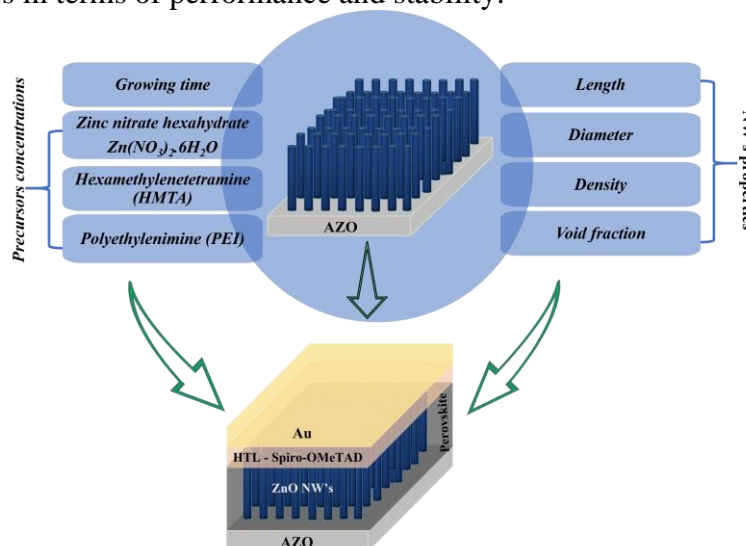
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The electron transport layer (ETL) plays a crucial part in perovskite solar cells (PSCs) to efficiently extract electrons and simultaneously block holes from the absorber. Therefore, ZnO nanowires (ZnO NWs) were grown over Aluminium-doped Zinc Oxide (AZO) substrates as an ETL using a hydrothermal growth (HTG) method [1] to fabricate FTO - free PSCs [2]. This study focuses first on the main parameters of the NWs growth, such as hydrothermal precursors concentrations (Zinc nitrate hexahydrate, Hexamethylenetetramine, Polyethylenimine) and growing time, to efficiently control the NW properties such as length, diameter, density and a void fraction (Fig. 1). Then, the PSCs performances were investigated in relation with the previous parameters. Our results exhibit that long growing time and high zinc salt concentrations with un-smooth morphology (i.e., voids/pinholes) are unfavorable to the PSC performance. Moreover, AZO/ZnO-NWs-based devices have been fabricated and demonstrate better performance than AZO/ZnO or SnO<sub>2</sub> compact ETL-based devices. Finally, a promising HTL material based on carbazole moiety (Cz-Pyr) [3] has been used. These devices show similar performance compared to the AZO/ZnO-NWs/Perovskite/Spiro-OMeTAD/Au devices. Therefore, this research suggests that using ZnO-NWs grown over AZO substrates is a practical approach for the PSCs in terms of performance and stability.



**Figure 1:** Schematics of hydrothermally grown ZnO NWs for FTO – free PSCs.

## References :

- [1] C. Justeau *et al.*, *Materials*, **2019**, 12, 2511.
- [2] Vera La Ferrara *et al.*, *Mater. Res. Express*. **2017**, 4, 085025.
- [3] F. Al-Zohbi *et al.*, *New J. Chem.*, **2019**, 43, 12211-12214.