|  |  |  |  |
| --- | --- | --- | --- |
| **Title:** | Chronological progress in enhancing CIGS solar cell performance through window layer development: Fundamentals, synthesis, optimization | | |
| **Author(s) Name:** | Nadia Hartini Suhaimi, Mohammad Nur-E-Alam, Boon Kar Yap, K. Sobayel, Md. Helal Miah, Mohammad Aminul Islam, Sieh Kiong Tiong, Narottam Das, Mayeen Uddin Khandakher, Nowshad Amin | | |
| **Contact Email(s):** | nowshad@aiub.edu | | |
| **Published Journal Name:** | [Surfaces and Interfaces](https://www.sciencedirect.com/journal/surfaces-and-interfaces) | | |
| **Type of Publication:** | Journal | | |
| **Volume:** | 54 | Issue |  |
| **Publisher:** | Elsevier | | |
| **Publication Date:** | Nov 2024 | | |
| **ISSN:** | 2468-0230 | | |
| **DOI:** | <https://doi.org/10.1016/j.surfin.2024.105145> | | |
| **URL:** | <https://www.sciencedirect.com/science/article/pii/S2468023024013014?via%3Dihub#ack0001> | | |
| **Other Related Info.:** |  | | |
|  | | | |

|  |  |
| --- | --- |
| **Abstract:** |  |
| Several factors, particularly the material of the window layer, contribute to the efficiency of CIGS solar cells. To optimize light absorption and reduce energy losses, it is critical to select the appropriate material for the window layer development. Thus, the main emphasis of this review is on the development of window layers, covering fundamental concepts, synthesis techniques, characterization methods, and optimization strategies. Metal oxides and doped metal oxides are critical materials for optimizing charge carrier flow, minimizing energy loss, and elevating sunlight transmission to the CIGS absorber. Despite tremendous progress, difficulties such as increased conductivity, transparency, stability, and cost-effectiveness remain. Discovering novel materials, specific combinations, and improved deposition techniques offers further details on the structure-property relationships of window layers. Addressing these difficulties is critical to improving the performance of CIGS solar cells, which are now approximately 23.6 % efficient. These enhancements are critical for progressing sustainable energy solutions. | |