

Title: Progress, Prospects and Challenges of MXene Integrated Optoelectronics Devices**Author Names:** Md. Tanvir Hossain, Md. Reazuddin Repon, Md. Abdus Shahid, Ayub Ali, Tarikul Islam

Abstract: Recently, the emerging 2D materials MXene have gained a surge of attention to the production of optoelectronics devices such as solar cells, plasmonic, phototransistors, photodetectors, light-emitting diodes, photothermal therapy, and so on. Its outstanding optical and electrical characteristics, unique structure, and large specific surface area make it suitable for future use in modern optoelectronics including ultrafast lasers, light emitters, modulators, and plasmonic generators. There is a lack of critical analysis on the prospects, challenges, overview of synthesis methods, mechanisms, and future research directions of MXene despite having some reviews have been published on the applications of MXene. Therefore, this study critically analyzed the existing challenges of MXene, such as poor stability in an oxygen environment, inadequate mechanical properties, ease of stacking, temperature barrier, and so on. In addition, the fundamentals, preparation techniques, properties, and applications of MXene have been summarized. The mechanism, limitations, and benefits of different preparation methods have been mentioned. A comprehensive analysis and guidelines have been provided to improve the existing synthesis methods. The ways to overcome these challenges, prospects, and future markets of the MXene-based optoelectronic devices have been described.

Key words: MXene, 2D materials, Optoelectronic devices, Synthesis methods, Photodetectors, Photothermal therapy, Material stability, Future prospects

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