

Title: Insights and potentials of two-dimensional black phosphorous-based solar cells

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Abstract: Understanding regional climatic trends is crucial for taking appropriate actions to mitigate the impacts of climate change and managing water resources effectively. This study aims to investigate the dissimilarities and similarities among various climate stations in Bangladesh from 1981 to 2021. Fuzzy C-means (FCM) and K-means clustering techniques were employed to identify regions with comparable rainfall patterns. Moreover, the innovative trend analysis (ITA) and the Mann-Kendall (MK) test family were utilized to analyze rainfall trends. The results indicate that both K-means and FCM methods successfully detected two rainfall regions in Bangladesh with distinct patterns. The ITA curve analysis revealed that out of the 29 stations, 13 had a non-monotonic increasing trend having no monotonic increasing trend, 8 had a non-monotonic decreasing trend, and 8 exhibited a monotonic decreasing trend. Additionally, the MK tests employed in the study showed predominantly negative trends across Bangladesh. The majority of stations (65.51%) fell into Cluster 1, while the remaining 34.48% were in Cluster 2. In terms of ITA analysis, 17.24% of stations exhibited a monotonic decrease, while there were no stations with a monotonic increase. However, 37.93% of stations showed a non-monotonic increase, and 44.83% displayed a non-monotonic decrease. These identified regions can provide valuable insights for water resource management, disaster risk reduction, and agricultural planning. Moreover, detailed rainfall analysis can help policymakers and scientists develop sustainable and effective regional-scale policies for managing the country's flood and drought situations, ultimately supporting agricultural development and environmental planning.

Keywords: Black phosphorus (BP), Two-dimensional materials, Solar cells, Renewable energy, Tunable bandgap, Carrier mobility, Optoelectronic properties

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