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Deep Learning Assisted Raman Spectroscopy for Rapid Identification of 2D Materials

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Two-dimensional (2D) materials are gaining significant attention for their unique properties and potential applications. Raman spectroscopy is a rapid, non-destructive tool for characterizing these materials, but traditional analysis methods are often time-consuming and subjective. In this study, we leverage deep learning, including classificatory and generative models, to enhance Raman spectra analysis for 2D materials. To address the challenges of limited and unevenly distributed data, we use Denoising Diffusion Probabilistic Models (DDPM) for data augmentation and develop a four-layer Convolutional Neural Network (CNN) for classification. Our CNN model achieves an accuracy of 98.8%, with the DDPM-CNN approach reaching 100% classification accuracy, demonstrating the method's effectiveness and reliability in automated material analysis. This work highlights the potential of deep learning-assisted Raman spectroscopy for precise and rapid 2D material characterization.

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