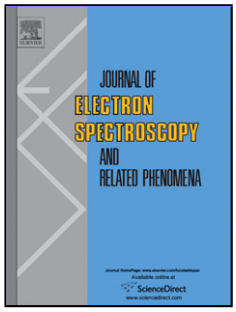

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Effect of uni-axial and bi-axial strains and vertical electric field on free standing buckled germanene

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Highlights

- By applying the vertical electric field on germanene sheet a small band gap at the K point is opened.
- The vertical electric field only affects the optical spectra in the low energy range
- Band structure of germanene under small biaxial strain remains unchaged near the K point.
- The inter-band transitions are red (blue)-shifted for uni- and bi-axial tensile (compressive) strains.

In this work, the effects of small uni-axial and bi-axial strains and vertical electric field on the band dispersion and dielectric response of germanene are studied by density functional theory. The results show that by applying the vertical electric field a small band gap at the K point is opened in germanene. The created band gap increases with electric field. The vertical electric field only affects the optical spectra in the low energy range below 1 eV. The band structure of germanene under small biaxial strain maintains the feature of bands near the K point without applying the strain, including a pair of two linear dispersive bands crossing at the Fermi level and the Dirac point position. The CBM