

Supplementary Materials

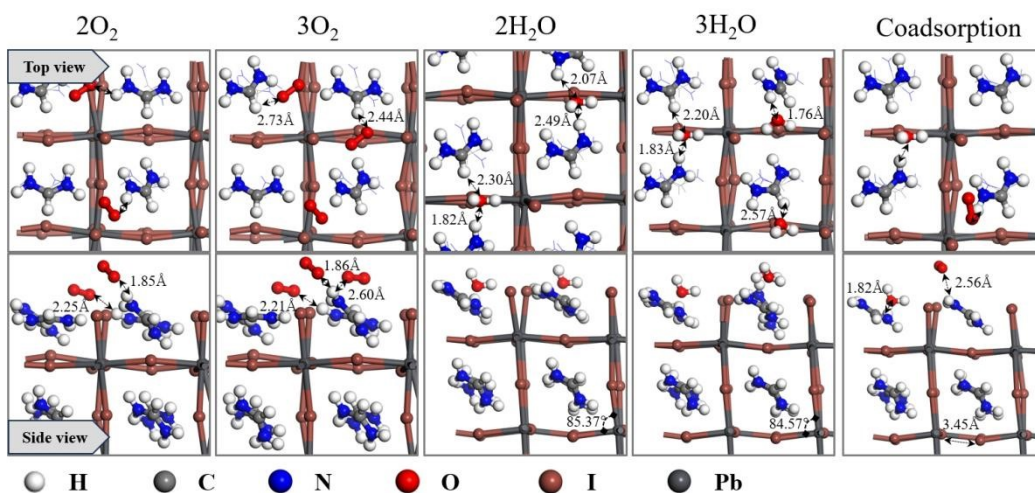


Figure S1. Multi-molecular adsorption of H_2O and O_2 on the surface of FAIS.

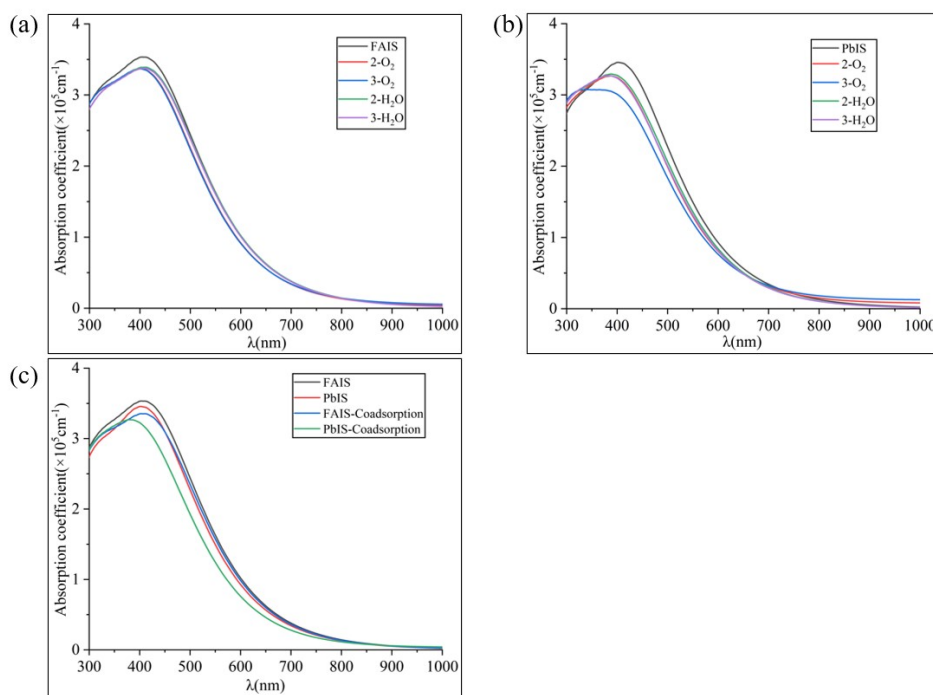


Figure S2. (a) Optical absorption spectra of FAIS and multi-molecular adsorption, (b) Optical absorption spectra of PbIS and multi-molecular adsorption, (c) Optical absorption spectra of FAIS and PbIS and co-adsorption.

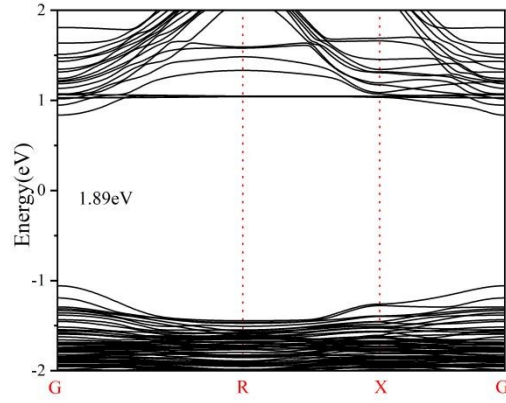


Figure S3. The band gap of three O₂ molecules adsorbed in PbIS.

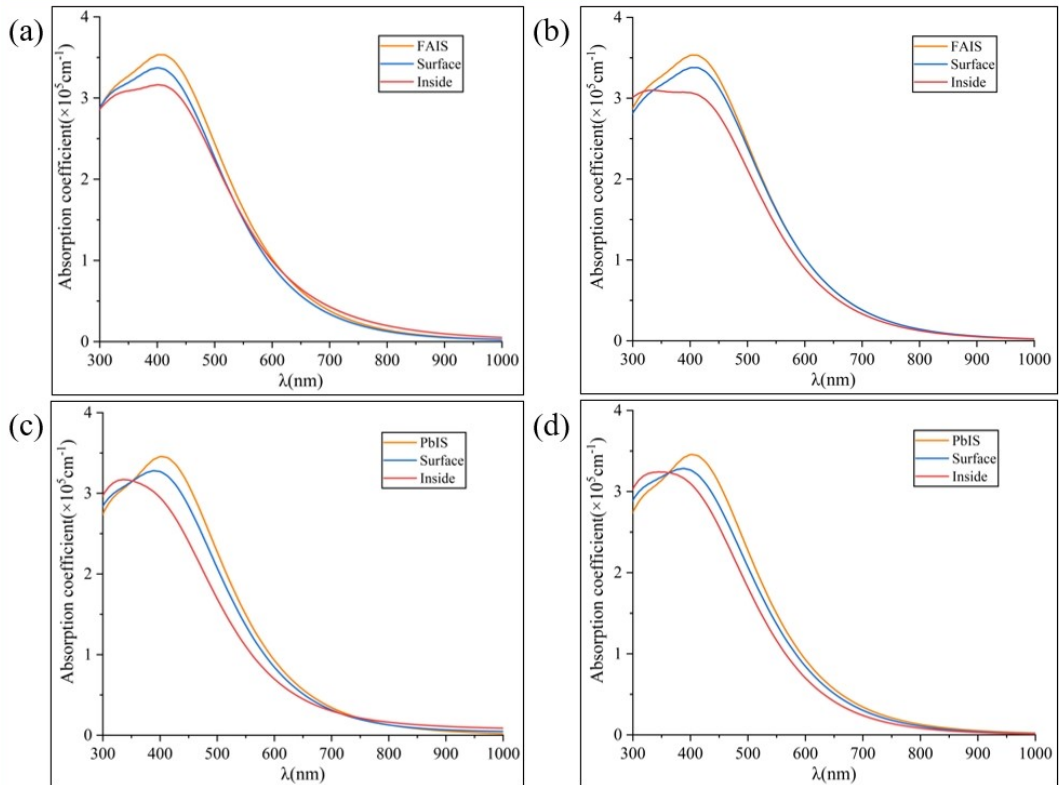


Figure S4. (a) Absorption spectra of O₂ adsorbed on the surface of FAIS and into the interior of FAIS, (b) Absorption spectra of H₂O adsorbed on the surface of FAIS and into the interior of FAIS, (c) Absorption spectra of O₂ adsorbed on the surface of PbIS and inside PbIS, (d) Absorption spectra of H₂O adsorbed on the surface of PbIS and into the interior of PbIS.

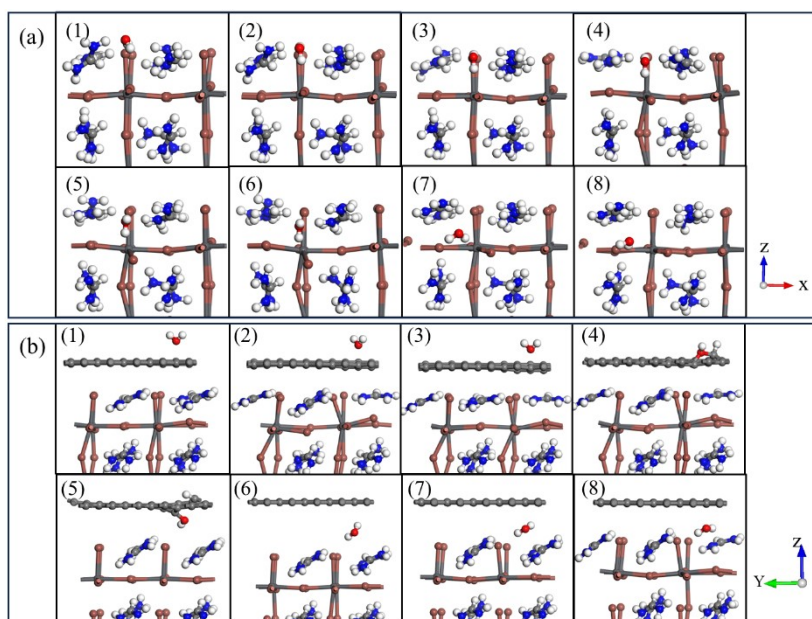


Figure S5. Diffusion paths of H₂O entering the FAIS surface and the graphene/FAIS hetero-junction.

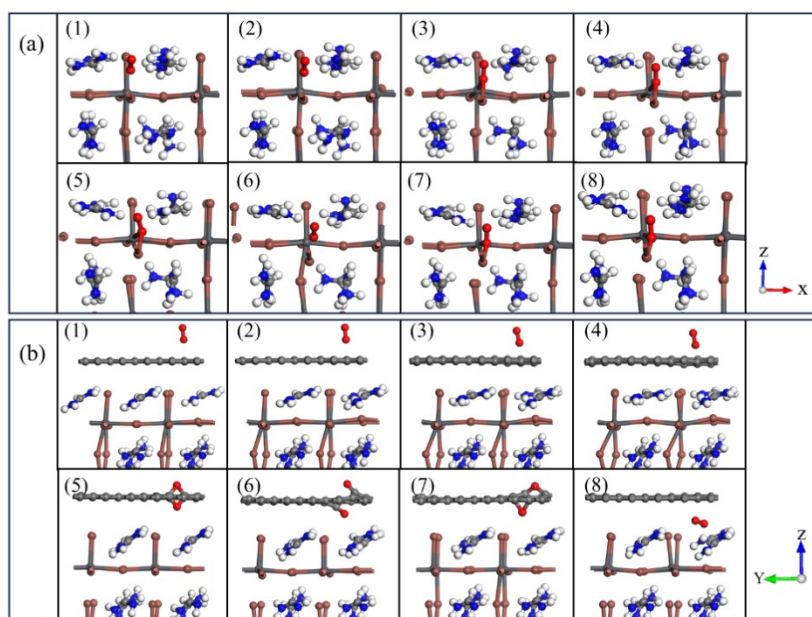


Figure S6. Diffusion paths of O₂ entering the FAIS surface and the graphene/FAIS hetero-junction.

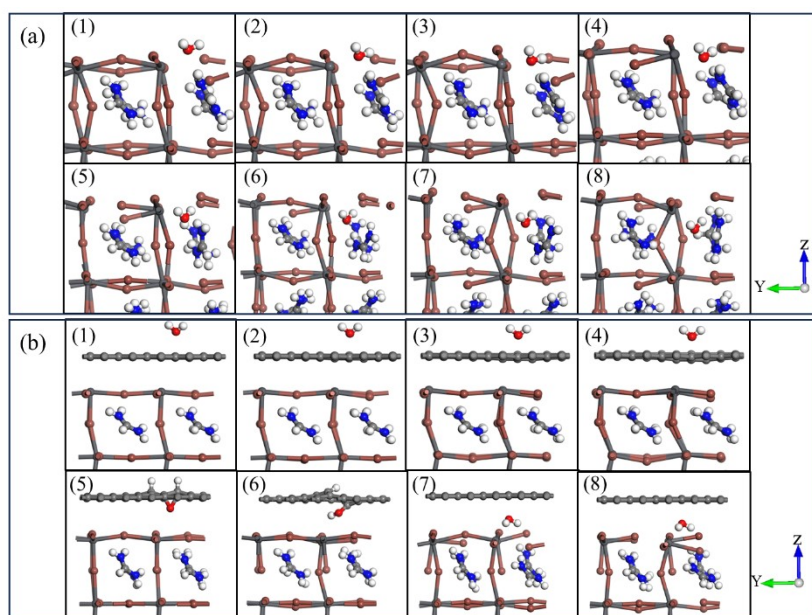


Figure S7. Diffusion paths of H₂O entering the PbIS surface and the graphene/PbIS hetero-junction.

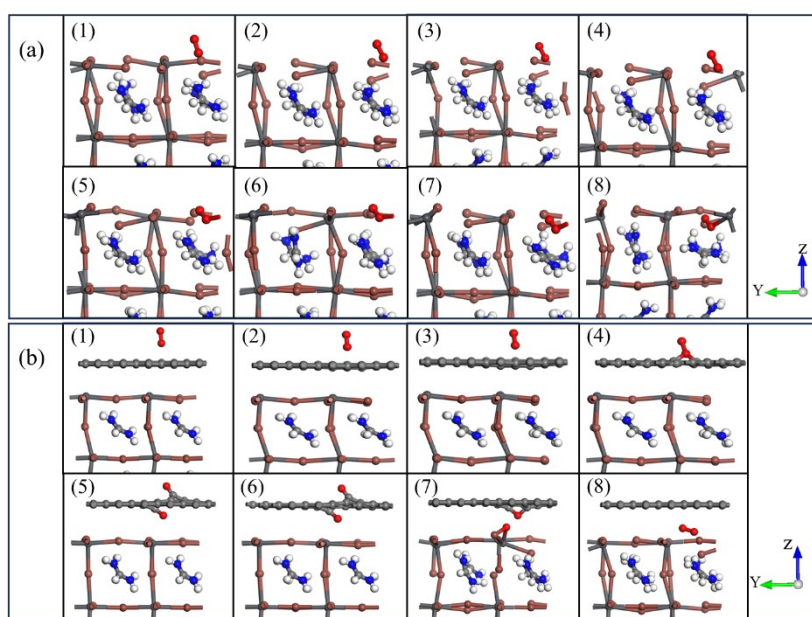


Figure S8. O₂ Diffusion paths of O₂ entering the PbIS surface and the graphene/PbIS hetero-junction.

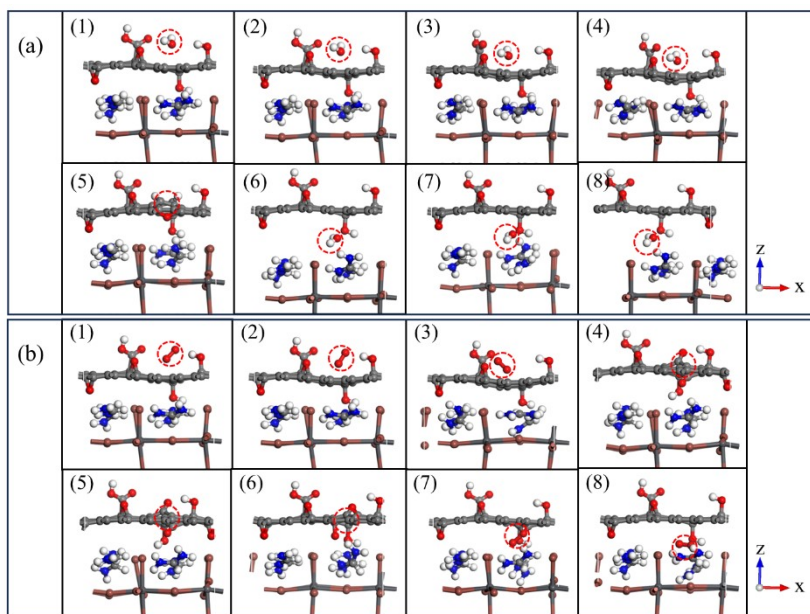


Figure S9. Diffusion paths of H₂O and O₂ entering the GO/FAIS hetero-junction.

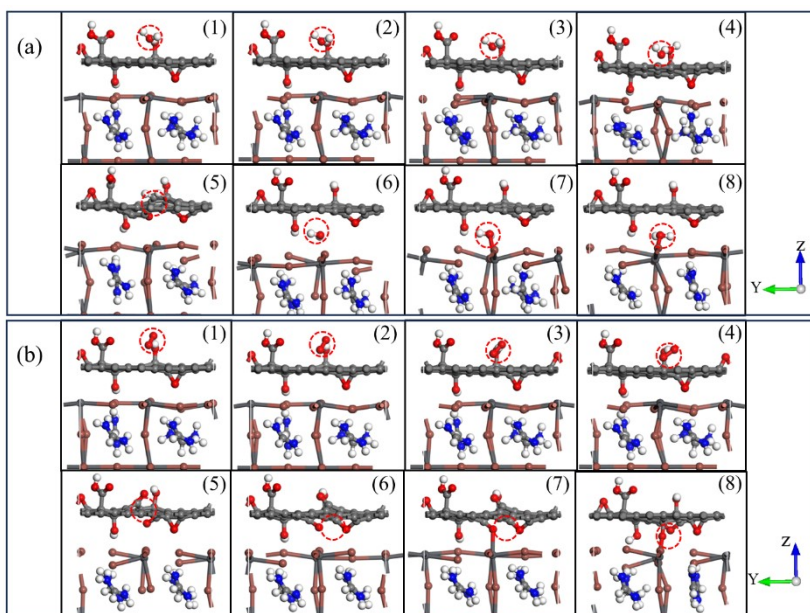


Figure S10. Diffusion paths of H₂O and O₂ entering the GO/PBIS hetero-junction.

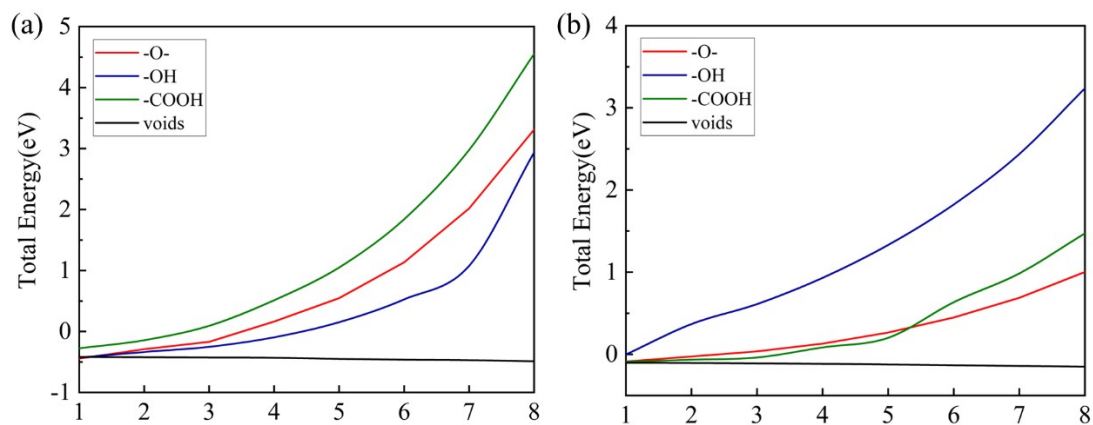


Figure S11. (a) and (b) indicate the Interaction energy of H₂O and O₂ to GO, respectively. Voids are located in the -O- , -OH and -COOH functional groups and exposed positions away from the functional groups (x-axis 1-8 indicates the number of steps close to the functional group, step size is 0.15Å)

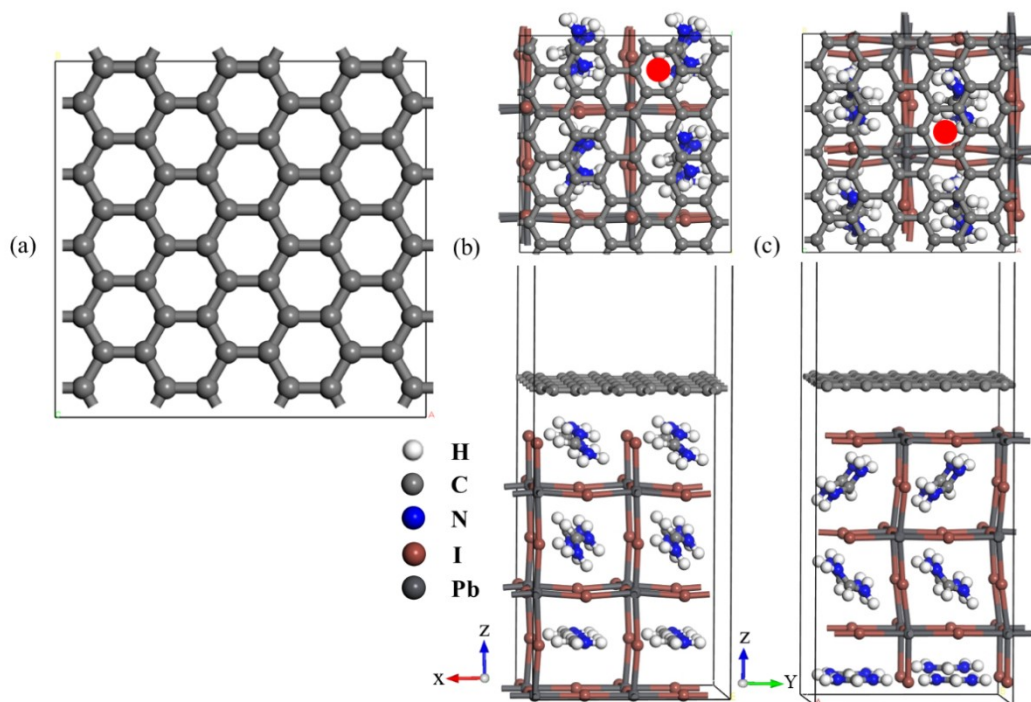
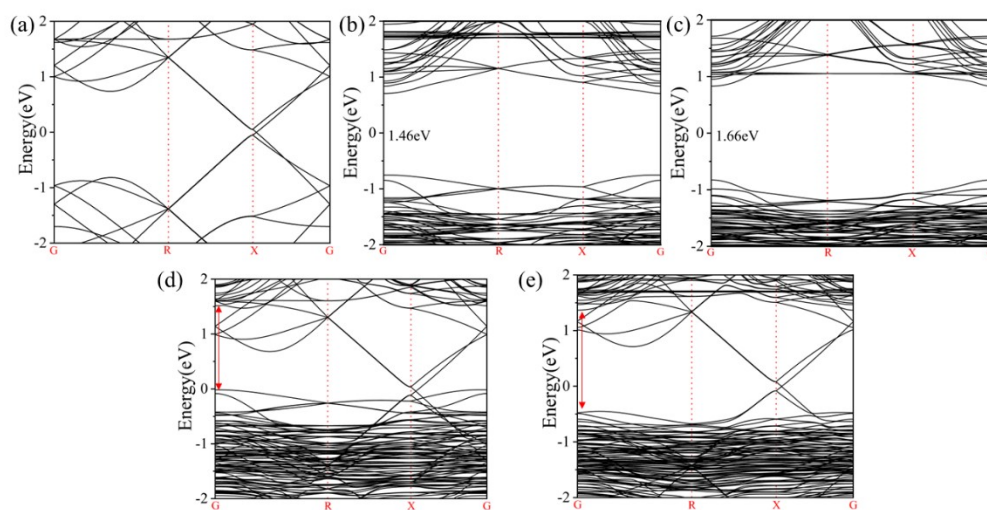


Figure S12. (a) Structure of the graphene sheet. (b) Structure of FAIS/graphene heterojunction. (c) Structure of PbIS/graphene hetero-junction. The specific location of the Void is shown in the red ball markings in Figures (b) and (c).



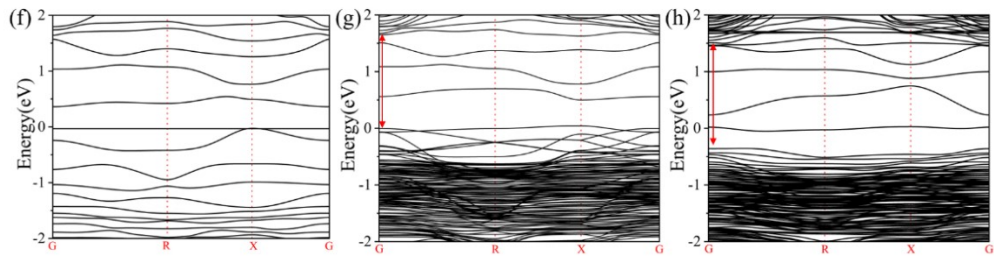


Figure S13. (a) The band structure of graphene, (b-c)The band structures of FAIS and PbIS surfaces, (d-e) the band structures of graphene/FAIS and graphene/PbIS heterojunctions, (f) The band structure of GO, (g-h) the band structures of GO/FAIS and GO/PbIS.