Biomimetic protection of phosphorene via sequestration of reactive oxygen species

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Few-layer black phosphorous (BP), commonly referred as phosphorene, has recently emerged as a promising candidate for next generation nanophotonic and nanoelectronic devices. However, rapid ambient degradation of mechanically-exfoliated BP poses challenges in its practical deployment in scalable devices.[1] To-date, the strategies employed to protect BP have relied upon preventing its exposure to atmospheric conditions.[2,3,4] We report an approach that allows this sensitive material to remain stable without requiring its isolation from the ambient environment. Our method draws inspiration from the unique ability of biological systems to avoid photo-oxidative damages caused by reactive oxygen species (ROS).[5] Since BP undergoes similar photo-oxidative degradation,[3,6] we employ imidazolium-based ionic liquids (ILs) as quenchers of these damaging species on the BP surface. This chemical sequestration strategy allows BP to remain stable for over thirteen weeks, while retaining its key electronic characteristics. This study opens opportunities to practically implement BP and other environmentally-sensitive two-dimensional (2D) materials for electronic applications.

References

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Figures

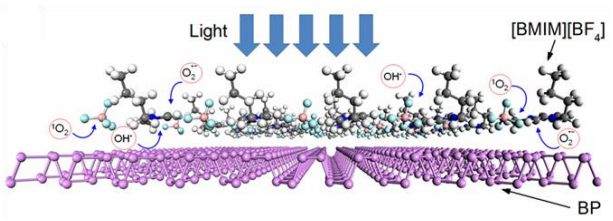

Figure 1: A schematic representation of [BMIM][BF_4] ionic liquid-induced sequestration of reactive oxygen species (ROS) on the phosphorene surface to avoid it's degradation under ambient conditions.