

Electrochemically One-Step Fabrication of AlO_x Passivated Black Phosphorene

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Abstract

Black phosphorus (BP), an emerging cost-effective 2D material with high carrier mobility (up to 10 000 cm² V⁻¹ s⁻¹), thickness-dependent band gap (from 0.3 eV for bulk to 2.0 eV for monolayer), and unique anisotropic nature, has piqued researchers' interest in electronics, catalysis, sensing, and energy storage.¹⁻² However, the thin-layered BP is unstable and easy to be degraded under ambient conditions, extremely limiting its practical applications. To protect BP from degradation, numerous methods mainly including physical encapsulation and chemical treatments have been applied and somehow work well.³ In instance, Al₂O₃ passivated few-layer BP prepared by atomic layer deposition (ALD) can be stable in air for more than 100 hours. Nevertheless, the problem concerning to control the quality of passivation layers is still unsolved. On the other hand, ALD method is usually expensive and hard to prepare a big batch of samples. In this work, the electrochemical deposition method combined with top-down electrochemical exfoliation of bulk BP was applied to realize one-step fabrication of the aluminum oxide passivated exfoliated BP. The measured BP was confirmed to be homogeneously decorated by aluminum oxide. We further present their air stability and thermal stability by AFM and Raman. The well passivated BP shows a stable air stability over 120 hours and greatly improved thermal stability.

References

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