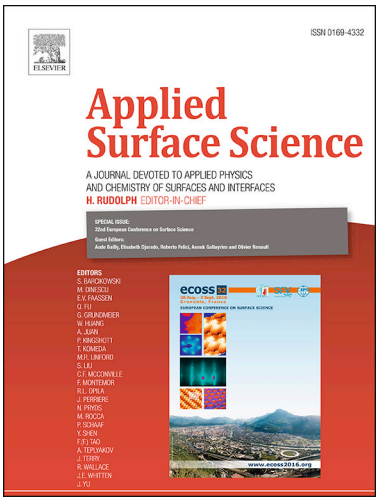


Full Length Article

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# Black Phosphorus Quantum Dot-based Field-effect Transistors with Ambipolar Characteristics

Soonjoo Seo[a], Byoungnam Park[b], Youngjun Kim[b], Hyun Uk Lee[a,*], Hyeran Kim[a], Seung youb Lee[a], Yooseok Kim[a], Jonghan Won[a], Youn Jung Kim[c] and Jouhahn Lee[a,*]

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Semiconductor quantum dots have intriguing electronic and optical properties distinguished from bulk owing to quantum confinement effects. Among the two-dimensional materials, black phosphorus (BP) has generated enormous excitement due to its tunable direct band gap and high p-type semiconducting properties. We prepared BP quantum dots (BPQDs) by simple liquid exfoliation using distilled water and ethanol solution. Our structural data show the uniform distribution of circular BPQDs with the average lateral size of 4.08 ± 0.66 nm and the height of 1.13±0.32 nm. We fabricated BPQD field-effect transistors (FETs) to investigate the electrical characteristics of BPQD-based devices and found that both hole and electron transport can be probed in the BPQD FETs. The BPQD FETs exhibited unprecedentedly ambipolar behavior with the mobility of 0.11 $cm^2V^{-1}s^{-1}$ for p type and 0.09