Two-Dimensional Transistors with Eco-friendly Solid Electrolyte Gating

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The increasing volume of electronic waste presents a huge environmental challenge (1). This study aims to address this problem through the use of eco-friendly solid-state polyelectrolytes such as xanthan gum, chitosan, and sodium alginate. These polyelectrolytes are utilized to construct Electric Double-Layer Transistors (EDLTs) with both graphene and MoS_2 channels.

The impact of polyelectrolyte gating upon graphene and MoS_2 are explored through the use of EDLT field-effect measurements, impedance spectroscopy and Hall-effect measurements. For all polyelectrolytes we observe high specific double layer capacitance 1-2 uF/cm^{-2} along with strong defect screening effects. Interestingly, the defect screening appears as a gradual process taking several hours to reach steady state. The physical origin of this effect is discussed (2).

A notable achievement of this project is the first reporting of graphene and MoS_2 EDLTs with xanthan gum and sodium alginate-based electrolytes.

References

[1] Olanrewaju S. Shittu, Ian D. Williams and Peter J. Shaw, Waste Management, (2021) 549-563.
[2] Ming-Wei Lin, Lezhang Liu, Qing Lan, Xuebin Tan, Kulwinder S Dhindsa, Peng Zeng, Vaman M Naik, Mark Ming-Cheng Cheng and Zhixian Zhou, JOURNAL OF PHYSICS D: APPLIED PHYSICS, 34 (2012) 345102.