Catalytic CVD Growth of Self-Organized Mo_2C/Graphene Core-Shell Anodes for Lithium-Ion Batteries

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Abstract

Metal catalysts have played a pivotal role in enabling new growth paradigms in the chemical vapor deposition (CVD) of graphene. In this work, we report the synthesis of few-layer graphene using molybdenum (Mo) thin films deposited on SiO_2/Si substrates. Unlike conventional surface-mediated growth, the carbide-forming nature of Mo facilitates graphene formation via bulk carbon segregation. Cross-sectional transmission electron microscopy reveals the formation of few-layer graphene both on the catalyst surface and at the SiO_2-Mo interface. This process is accompanied by the formation of Mo_2C nano-islands arising from thermally induced dewetting. Comparative growth on sapphire substrates highlights the critical influence of catalyst-substrate interactions and catalyst morphology in governing graphene nucleation and evolution. The growth behaviour exhibits strong resemblance to the tip-growth mechanism observed in carbon nanotube synthesis, resulting in Mo_2C/graphene core-shell architectures. Electrochemical evaluation of the transferred graphene/Mo_2C hybrid film on stainless steel demonstrates an areal capacity of 14 μAh cm^{-2} with 86 % capacity retention over 100 cycles at a current density of 0.5 μA cm^{-2}. These findings provide new insights into carbide-mediated graphene growth and demonstrate the potential of Mo_2C/graphene hybrid structures as promising binder-free anodes for next-generation lithium-ion microbatteries.

References

[1] Navanya Raveendran, Sruthy Subash, Krishna Moorthy Ponnusamy, Preethu P Satheesh, Keun Heo, K. Kamala Bharathi, and S. Chandramohan, ACS Applied Nano Materials 7 (10), 11827-11838 (2024).

Figures

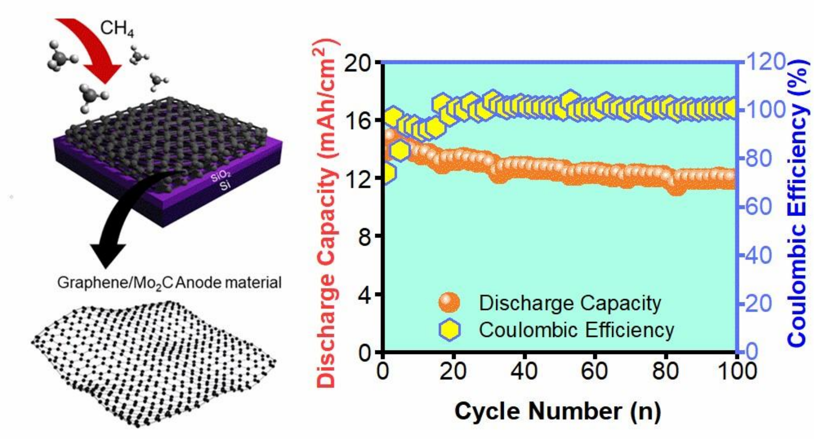

Figure 1: Schematic representation of Graphene/Mo_2C anode and the cyclic performance with coulombic efficiency for 100 cycles.

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