Phytochemically derived layered graphitic carbon/NiO nanocomposite for energy storage application

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Abstract

Biomass-derived porous graphitic carbonaceous materials have gained considerable attention nowadays due to their eco-friendliness and low cost [1]. Those substances are renowned for their use in various applications, including energy storage devices. The high surface area, porosity, and attached oxygen functional groups impart high specific capacitance via the electric double-layer capacitance (EDLC) mechanism [2]. Recently, research has focused on developing transition-metal oxide/graphitic carbon composite to incorporate pseudo-capacitance alongside EDLC. Among these, NiO is one of the best candidates due to its high chemical-thermal stability, low cost, suitable theoretical specific capacitance, and great reversible redox reaction [2]. Here, a phytochemical-derived synthesis strategy is adopted to develop a NiO/C binary nanocomposite. Phytochemicals present in the seed extract serve as a rich source of carbon and also contribute to the formation of layered graphitic carbon. XRD and XPS confirm the presence of NiO. The honeycomb lattice symmetry observed from the SAED pattern indicates the formation of a graphitic carbon layer. The presence of D, G, and 2D bands, along with a lower I_D/I_G ratio, also suggests high graphitic ordering of carbon in the sample. The electrochemical performance of the material is studied using a three-electrode setup in an alkaline medium and obtained specific capacitance value, 40 F/g for 1A/g current density. The effect of redox additive in the electrolyte is also studied.

References

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[2] Ray, S. K., Kokayi, M., Desai, R., Dahal, R., Ashie, M. D., Mantripragada, S., & Bastakoti, B. P, Materials Chemistry and Physics, *320*, (2024) 129403.

Figures

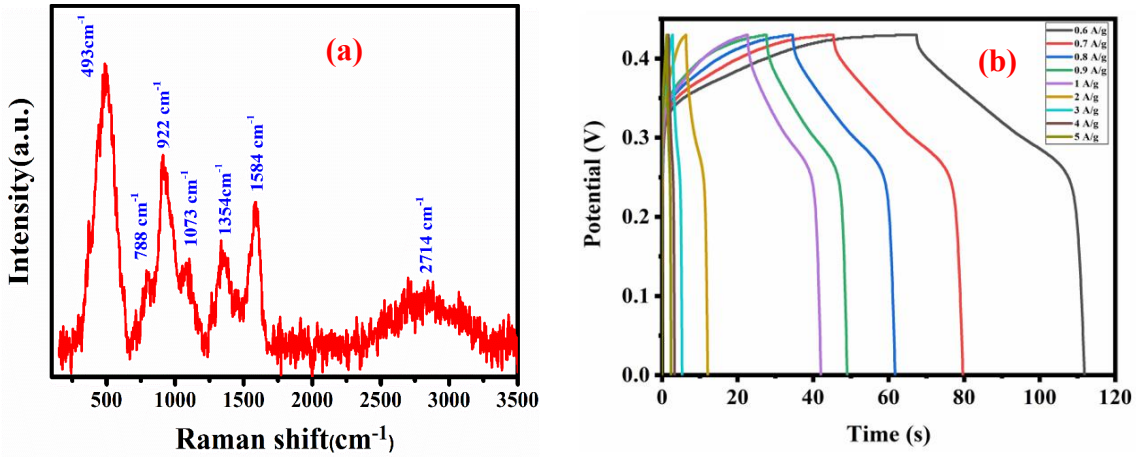

Figure 1: (a) Raman spectrum of the sample and (b) GCD plot at different current densities alkaline medium.