Synthesis of high energy density Bi-RGO anode materials for sodium ion batteries using simple supercritical reaction

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Bismuth (Bi) is one of the most promising material in sodium ion batteries due to its unique layered crystal structure. Large interlayer spacing of Bi along the c-axis has 3.95 Å spacing, which allows to accommodate Na^+ ions (diameter of sodium atom : 3.14 Å) with an alloy and intercalation mechanism [1,2]. In addition to its high theoretical capacity of 385 mAh g^{-1}, Bi has high volumetric capacity (3765 mAh cm^{-3}) because of the high density (9.78 g cm^{-3}), which also important consideration for large-scale energy storage applications. Herein, Bi-reduced graphene oxide (RGO) was synthesized in supercritical acetone. Under the supercritical condition, graphene oxide was reduced, and at the same time, Bi nanoparticles were simultaneously anchored onto the surface of RGO within 1 min. Because of the high- density metallic Bi, Bi-RGO composite exhibited three times higher tap density than that of RGO (Figure 1a). In addition, the homogeneously deposited Bi nanoparticles on RGO surface could effectively suppress the structural pulverization caused by the volume expansion. The Bi-RGO delivered a high reversible volumetic capacity of 60 Ah L^{-1} with much improved cycling stability as compared to those of Bi and RGO (Figure 1b).

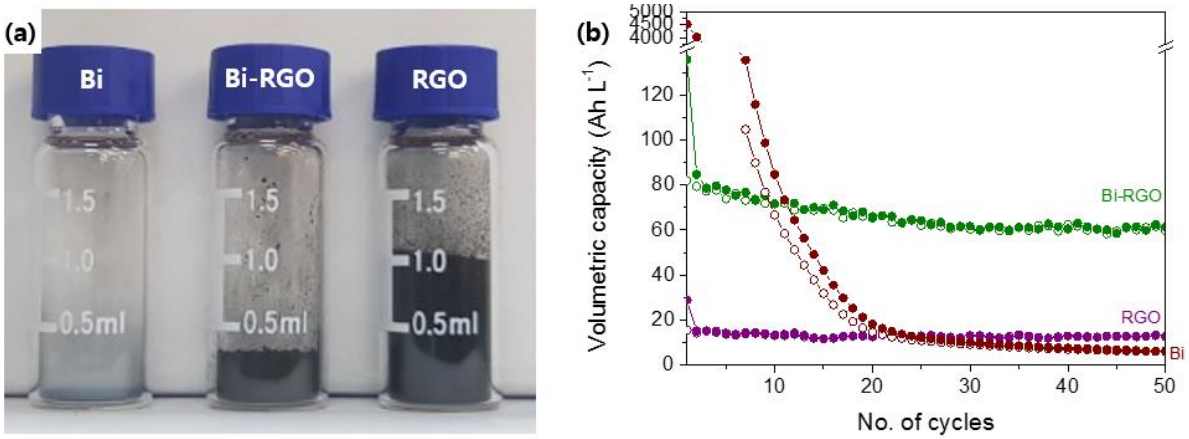

Figure 1. (a) Tap density image of Bi samples containing same amount and (b) Volumetric capacity comparison of Bi-RGO and RGO.

References:
[1] D. Su, S. Dou, G. Wang, Nano Energy 12 (2015) 88-95.
[2] S. Liu, J. Feng, X. Bian, J. Liu, H. Xu, J. Mater. Chem. A 4 (2016) 10098-10104.