Recent advancements in Chemical Vapor Deposition (CVD) techniques had facilitated growth of graphene on various metallic substrates. While high quality, two dimensional graphene growth is achievable using existing techniques, many applications such as energy storage call for structures with a 3D architecture. Having a third dimension has several advantages, the major one being increased surface area. It is not very practical to deposit a two dimensional material such as graphene on to high aspect ratio three dimensional structures efficiently. In this work, a scalable one step chemical vapor deposition technique has been developed for controlled etching and simultaneous graphene growth on the surface of metals such as copper and stainless steel. MoS$_2$ was chosen as a model electrode to test the efficacy of such 3D architecture current collectors. A thin layer of electrode was conformally deposited on to the porous structure and tested as an anode of a Lithium ion battery. The structural and morphology of the current collector/electrode hybrid structures were characterized by X-ray diffraction, X-ray photoelectron spectroscopy (XPS) analysis, scanning electron microscopy and energy-dispersive X-ray spectroscopy. The contribution of 3D current collectors resulted in excellent cyclic stability and capacity compared to using conventional 2D configuration.

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