Pulsed Photoinitiated Fabrication of Transition Metal Oxides-Reduced Graphitic Oxides Nanocomposite Thin Films

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Abstract:

Nanocomposite thin films of transition metal oxides and carbon nanomaterials have great potential for electrode materials application in electrochemical energy conversion and storage, and chemical sensors. However, the cost-efficient manufacturing has been a significant challenge for conventional chemical and physical techniques. Herein I report a pulsed photoinitiated approach to rapid in-situ synthesis of three-dimensional (3-D) nanostructured composite thin film of nanocrystalline transition metal oxides and reduced graphitic oxides (rGO) through pulsed light (flash lamp) irradiation of metal-organic precursor films. The instantaneous photoinitiated pyrolysis occurs in the first couple pulses of light irradiation and results in the composite thin films with a 3-D nanostructure that includes a porous top dendritic layer and a dense bottom layer. Subsequent pulsed light irradiation works as in-situ post-treatment through pulsed photothermal effect. This novel approach has been applied to synthesize 3-D nanostructured TiO_2-rGO, cobalt oxides-rGO and iron oxides-rGO composite thin films. This work is opening a way to practical application of the pulsed photoinitiated nanofabrication technology and the photoinitiated metal oxide-based nanocomposite thin films.