Graphene / TiO_2 Composite Electrode for Oxygen Reduction

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Abstract

A commercial graphite nanocrystals was oxidized to graphene oxide (GO) using Hummers' method. Later, GO powder was reduced either by placing it under a H_2 gas flow in a controlled gas reactor at 450 ^oC or using a hydrazine hydrate solution (HH) in a 1000-Watt microwave oven. X-ray photoelectron spectroscopy (XPS) and X-ray diffraction patterns (XRD) confirmed that both of the oxidation and reduction processes of graphite and GO powders, respectively, were incomplete. Also, the surface area of the H_2 gas - reduced GO powder was found to be higher than the case where HH was used to reduce the same powder. Fourier transform infrared spectroscopy (FT-IR) and XPS (Figure 1) have revealed that GO surface consists mainly of hydroxyl, epoxy, carbonyl and carboxylic groups. The electrocatalytic properties of (i) glassy carbon (GC), (ii) commercial TiO_2 (P25-TiO_2/GC), (iii) TiO_2-supported GO (GO/TiO_2/GC), (iv) TiO_2 – supported HH – reduced GO (HHRGO/TiO_2/GC) and (v) TiO_2 – supported H_2 gas – reduced GO (H_2RGO/TiO_2/GC) electrodes towards the oxygen reduction reaction (ORR) in acidic solution in presence and absence of UV radiation were examined. The results have shown that the H_2RGO/TiO_2/GC electrode has the best electrocatalytic activity in terms of current at a certain potential but glassy carbon electrode (GC) was found to be the best in terms of the onset potential of the ORR.

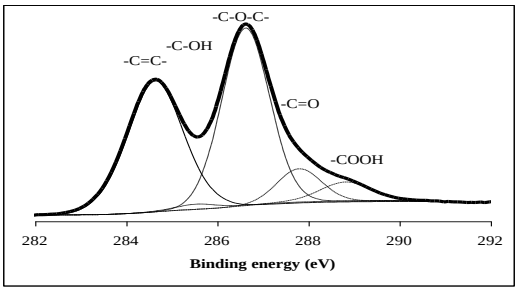

Figure 1: XPS of GO