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Electric field poling effect on the electrocatalytic properties of nitrogen functionalized graphene nanosheets

Maryam Jahan
Southern University and A and M College, USA

Fuel cells are attractive new technologies for producing sustainable and green energy. However, the high cost of its components such as Pt electrocatalyst is a major challenge. Heteroatom doped carbon nano-materials show potential applications for oxygen reduction reaction (ORR) which can be used for fuel cells and may be the promising replacement of Pt catalyst. Recently, we implemented a facile method for preparing partially nitrogen functionalized graphene oxide (PNG) nano-sheets. To achieve better nitrogen functionalization, graphene oxide was annealed in ammonia solution for 12h at 220^0C. The electrochemical measurement data show that the PNG synthesized in NH3 environment possesses good electrocatalytic activities for ORR. In addition, we identified a physical method for the first time to drive the randomly oriented graphene nano-sheets to be aligned parallel to the surface of the electrode for electrocatalytic application by using an AC electric field. An additional effect of the applied electric field is the induction of polarization on PNG nano-sheets that create a dielectrophoresis phenomenon, in which an attractive force is recruited to assist the packing of the nano-sheets rendering a compact surface. The pooling effect of the electric field on the sample shows much improved electrocatalytic performance. The enhanced catalysis can be used for ORR as an important reaction in fuel cells. The reported new method can achieve a low-cost capability for preparing new electrocatalyst electrodes for large-scale applications.

maryam_jahan@subr.edu