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A.A.El-Shafei

Mansoura University, Egypt

Noble metal nanoparticles impregnated into zeolites for ethanol oxidation reaction in alkaline medium

Nowadays, the direct ethanol fuel cell (DEFC) with the electro-oxidation of ethanol as its anode reaction is becoming a promising green power source for portable device applications owing to its advantages of higher open circuit voltage, high current density, safer fuel and easy to handle compared to Hydrogen. In spite of the research effort to find out a cheap anode with high performance for fuel cell application, expensive noble metals are still in use. For this reason, more effort must be devoted to reduce the amount of noble metal loading while the high reactivity is still retained. In order to fulfill this demand, high dispersion of noble metal-containing catalyst on different cheap and conducting substrates has been extensively studied. In this work, noble metal nanoparticles dispersed in zeolites layer have been prepared, by loading the Zeolites layer onto graphite substrate using drop casting technique, followed by impregnation into metal salt solution, and then tested for ethanol oxidation in alkaline solution using cyclic voltammetry and chronoamperometry techniques. Finally, the catalyst layer morphology was examined by electron microscopy. The noble metal/zeolites modified graphite electrodes (NZGE) show higher catalytic activity for ethanol oxidation in alkaline medium compared with massive noble metal or noble metal modified graphite electrodes (N/GE). The noble metals incorporated in the zeolite layer are Au and/or Pd. The activity of these electrodes depends on the amount of zeolites loaded on the graphite surface and on the soaking time in noble metal solution. The effects of both scan rate and ethanol concentration on the anodic peak height are indicative of a diffusion controlled process. Current decay measurements indicate that the activity of studied electrodes towards poisoning tolerance decreases in the following order: NZGE > N/GE > NE. Simultaneous immersion of zeolites modified graphite electrode in Au and Pd solution indicates that Pd can easily replace Au than Au can do. Among all studied NZGE, Au-PdZGE (prepared by immersion firstly in Pd solution followed by immersion in Au one) exhibits the highest catalytic activity towards ethanol oxidation.

Biography

A.A. El-Shafei, Science Doctor (PhD-Chemistry), he became a full Professor of Physical Chemistry at Mansoura University in October 2001. He got his B Sc in chemistry, M Sc in Physical Chemistry and Specialist in electro-chemistry, Doctor's degree (PhD.) under channel system program (Bonn University, Germany & Mansoura University, Egypt).

El-Shafei acts as active participants in various electrochemist groups in Germany, Japan, France and USA. In 1994 he spent 6 months as a research associate at CNRS, France. He got various research fellowships from distinguished scientific organizations such as, AxVH, JSPS and JICA. Dr. El-Shafei got the Arab Fund for Economic & Social Development research award in 2006. He got the Prize of Distinction in chemistry from Mansoura University, 1998/1999. Currently Dr. El-Shafei researches focus on modified electrodes for fuel cell technology and corrosion inhibition. He has published more than 40 papers in reputed journals and has been serving as an editorial board member and reviewer of reputed international scientific journals.