Electro-Fenton process using a novel electrocatalyst of bimetallic Pt-Ir on multi-walled carbon nanotube: Environmental approach.

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There are many technologies and methods for water treatment and pollution control in water. Fenton process can be employed for degradation of organic compounds, this process involves the reaction between H_2O_2 and Fe^{2+} ions to produce •OH radicals. Electrochemical methods offers different pathways for •OH radicals generation by Fenton: (a) Fe^{2+} ions electro-generated (anodic Fenton); (b) H_2O_2 electro-generated by Oxygen Reduction Reaction (ORR) (cathodic Fenton).

In this study we reported an Electro-Fenton system using a novel electrocatalyst based on bimetallic Pt-Ir nanoparticles deposited on multiwall carbon nanotube (MWCNT) synthetized by microemulsion method. The electrocatalyst was dispersed with Nafion® to deposit a film onto reticulated vitreous carbon which was used as cathode in the electrochemical reactor for electro-Fenton system.

Electrochemical tests and physicochemical characterization were carried out to evaluate the best electrocatalytic material.

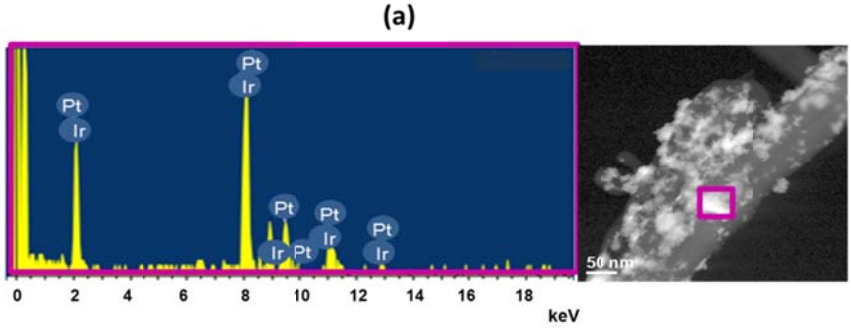

Figure 1. EDS spectra of Pt-Ir/MWNTC, TEM image shows the region analyzed.

Different cathode materials were tested for ORR, bimetallic Pt-Ir/MWCNT electrocatalyst showed higher activity than other materials. Also, only nanoparticulated Pt-Ir/MWCNT showed ORR with 2 electrons transferred, leading to H_2O_2 generation; meanwhile other materials performed 4 electrons transference in the same process. Also, the electrocatalyst exhibit a wide range of potential to ORR with two electrons transferred.

Bulk electrolysis were carried out, H_2O_2 concentrations were measured by iodometric titration method described in Reference [1]. It was noticeable that a higher H_2O_2 concentration was obtained by using Pt-Ir/MWCNT instead of Pt/MWCNT or Ir/MWCNT; however, the consumption of charge in bimetallic electrocatalyst is lower than other materials. Different Fe^{2+} ion concentration was investigated to obtain highest •OH radicals concentration. By using fluorescence spectroscopy on coumarin solution (λ_{em}=390 nm), •OH radicals were detected, measuring the new band assumed to 7-hydroxicoumarin (λ_{em}=453 nm) [2].

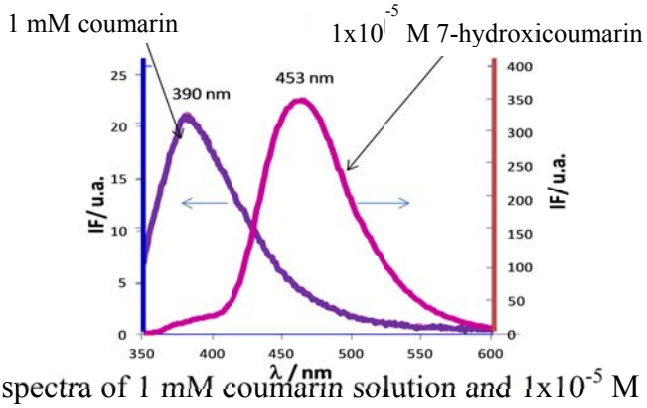

Figure 2. Fluorescence spectra of 1 mM coumarin solution and $1x10^{-5}$ M 7-hydroxicoumarin in acidic media.

Moreover, Pt-Ir/MWCNT cathode is a very stable and reusable electrode, no deactivation or passivation was detected in stability test.

Degradation of MTBE on aqueous solutions was carried out under best conditions by different electrochemical methods.

References

1. Frew, J. E.; Jones, P.; Scholes, G. *Anal. Chim. Acta* **1983**, 155, 139.
2. Komatsu, M.; Rao, T.; Fujishima, A. *Chem. Letters* **2003**, 32, 396.