Preparation and Characteristics of Ti-based SnO_2 Electro-catalytic Electrode

Yu-Jie Feng, Yu-Hong Cui

Department of Environmental Science & Technology, Harbin Institute of Technology, Box760, No92, Xidazhi Street, Harbin, 150001, P.R.China

Abstract

Aquatic wastes, containing aromatics are recalcitrant and toxic toward conventional biological treatment. Electrochemical process is an alternative degradation method, which is attractive for environmental compatibility[1] and especially, it is convenient for eletrolysis to be used either as electrochemical degradation or calcification[2-3]. Anodes with high stability, high activity and low cost are very important for a successful process. Previous work have found that electrodes either based on SnO_2 or minor component of SnO_2 in DSA anodes is quite interesting for its high oxygen evolution over-potential and attractive electro-catalytic characteristics[2~4]. It was found that when SnO_2 was introduced with Sb into the oxide coating, better electro-catalytic performance was observed[4].

Present work mainly focused on the investigation of the preparation method of Ti-based SnO_2 anode and some characteristics of the electrode were also studied. The electrochemical degradation efficiency to target pollutant (phenol) and the mechanism were reported. The relationship between the structure of coating compound on electrode surface and the electro-catalytic characteristics of the electrode was also determined.

The Ti-base SnO_2 electrode was prepared by electro-deposition and thermal oxidation. Layered structure on Ti surface was found and composition of two layers was analyzed. Fig.1 showed the micrographs of the surface structure of inter-layer and out-layer. The compositions of the two layers were listed in Table.1.

Taking phenol as a model substrate, the electro-catalytic oxidation characteristics of the prepared Ti/SnO_2 electrode were investigated. Each electrolysis cell consisted of an anode of Ti/SnO_2 with a square of 2 3 cm^2 and a stainless steel counter electrode, while Na_2SO_4 of 0.25M was selected as supporting electrolyte. It was found that when an electro-deposition inter-layer was employed onto the Ti substrate, the service-life and the electro-catalytic efficiency of Ti/SnO_2 electrode was increased, especially in COD removal, as shown in Fig.2. It also proved that the prepared Ti/SnO_2 electrode was able to mineralize organics completely, and a high oxygen over-voltage (about 2V) of this kind of electrode was demonstrated by LSV.

EPR and XPS were also employed at present study. Results illustrated that the electro-catalytic ability was highly associated with the distribution of oxygen vacancy in the SnO_2 crystal and it has been proved that this distribution can be changed when some foreign atoms introduced. The content and the distribution of oxygen vacancy have large association with the electro-catalytic performance of the anodes.

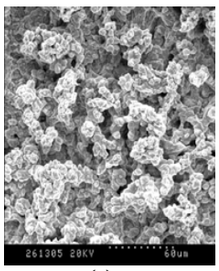
References:

1.K.Rajeshwar, J.G.Ibanez and G.M.Swain, J.Appl.Eletrochem, 24(1994),1077

2.Kotz, S Stucki, B Carcer. J. Appl. Electrochem, 1991;21:14

3.Yujie Feng etc., The Application of Electro- chemical Technique on Environ. Eng. Beijing: Chemical Press, 2002, P. R. China

4.Yujie Feng, X.Y.Li, The 199th Meeting of the Electrochemical Society, March 25~29, 2001. Washington DC, USA

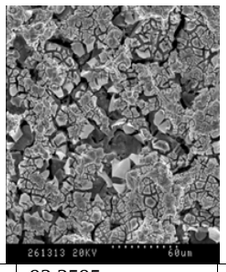


(a) (b)

Fig.1 Micrographs of the surface structure of the prepared electrode (a) Inter-layer, (b) Out-layer

Table. 1 EDX data of the prepared electrode

Element	Atom%(inter-layer)	Atom%(out-layer)
Sn	93.3595	95.8647
Sb	6.6405	4.1353



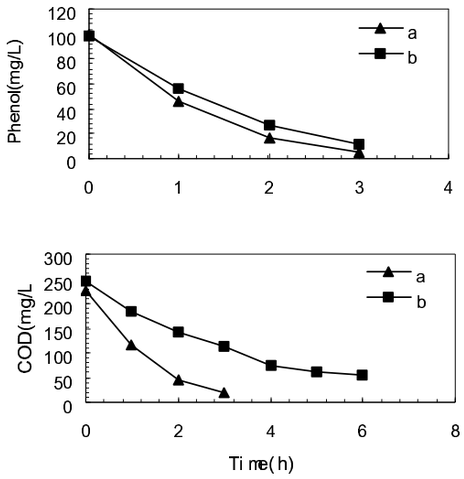


Fig.2 Phenol and COD removal vs time, phenol conc. 100ppm, electrolyte volume 100ml, I=10mA/cm2, (a) Ti/SnO2 electrode with inter-layer, (b) Ti/SnO2 electrode without inter-layer