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Study of organic sulfide electro-oxidation in a non-aqua media

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ABSTRACT

Electro-oxidation of methyl phenyl sulfide in a solution of 85:15 acetic acid and 1 M sodium hydroxide was investigated on the glassy carbon electrode (GC) by electrochemical techniques such as cyclic voltammetry (CV) and chronoamperometry (CA). Methyl phenyl sulfide was successfully oxidized. Kinetic studies were performed on the introduced system and data such as the diffusion coefficient (D^0), heterogeneous electron transfer rate constant (k_{et}) electron transfer coefficient (α) and catalytic rate constant (k) were determined for methyl phenyl sulfide electrochemical oxidation. Finally, a mechanism for electro-oxidation of sulfide was proposed.

The high performance of the glassy carbon electrode as an effective carbon-based metal-free electro-catalyst, no need of using oxidant and co-catalyst and designing a homogeneous media with proper conductivity for oxidation of insoluble in water compounds demonstrate important items for the use of this procedure in the subsequent investigation of sulfides.

Keywords: *Sulfides electro-oxidation, Electro-catalysis, glassy carbon electrode,*

1. INTRODUCTION

The development of pharmaceutical precursor synthesis and especially biologically active sulfoxides are very important for pharmaceutical companies because not only are they used in medicine and pharmacy but also are the best-selling medications[1]In recent years, designing an affordable and environmentally friendly process has been of great interest to researchers for the production of sulfoxide, and researchers have always tried to use green catalysts, oxidants, and solvents to produce it. likewise, oxidation of sulfides is vital in controlling water and environmental pollution[2].

Recently, many researchers use hydrogen peroxide as an oxidizing agent, because of low price and cleanliness. However, hydrogen peroxide alone does not perform well and along with it, some acids should be used as activators. In chemical oxidation methods, although the use of homogeneous catalysts has good efficiencies, their separation is very difficult[3]. Therefore, many researchers have used heterogeneous methods and used solid supports to stabilize the catalyst[3–9]. In heterogeneous methods, catalyst separation is easier, but after a while, the oxidation efficiency decreases due to the poisoning of the catalyst surface. Also, in chemical oxidation methods, the oxidizing agent sometimes destroys the catalyst.

On the other hand, electrochemical methods have more advantages than chemical methods[10]. In electrochemical methods, electro-catalyst plays a vital role in industrial production. Though noble metals and noble metal oxides are the most common electro-catalysts, there are some disadvantages such as high price, limited resources, and low selectivity and durability. Likewise, according to pourbaix diagrams, most non-noble metals such as Ni, Fe, Co are not stable in