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Electro-Oxidation of Glycerol Using Nickel Deposited Carbon Ceramic Electrode and Product Analysis Using High Performance Liquid Chromatography

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Abstract : Electro-oxidation of glycerol is an important process to convert the less price glycerol into other expensive (essential) and energy-rich chemicals. In this study, nickel was electro-deposited on laboratory-made carbon ceramic electrode (CCE) substrate using electrochemical techniques that is cyclic voltammetry (CV) to prepare an electro-catalyst (Ni/CCE) for electro-oxidation of glycerol. Carbon ceramic electrode was prepared from graphite and methyl tri-methoxy silane (MTMOS) through the processes called hydrolysis and condensation with methanol in acidic media (HCl) by a sol-gel technique. Physico-chemical characterization of bare CCE and modified (deposited) CCE (Ni/CCE) was measured and evaluated by Fourier Transform Infrared spectroscopy (FTIR), Scanning Electron Microscopy (SEM) and X-ray diffraction (XRD). Electro-oxidation of glycerol was performed in 0.1 M glycerol in alkaline media (0.5 M NaOH). High-Performance Liquid Chromatography (HPLC) technique was used to identify and determine the concentration of glycerol, reaction intermediates and oxidized products of glycerol after its electro-oxidation is performed. The conversion (%) of electro-oxidation of glycerol during 9-hour oxidation was 73% and 36% at 1.8V and 1.6V vs. RHE, respectively. Formate, oxalate, glycolate and glycerate are the main oxidation products of glycerol with selectivity (%) of 75%, 8.6%, 1.1% and 0.95 % at 1.8 V vs. RHE and 55.4%, 2.2%, 1.0% and 0.6% at 1.6 V vs. RHE respectively. The result indicates that formate is the main product in the electro-oxidation of glycerol on Ni/CCE using the indicated applied potentials.

Keywords : carbon-ceramic electrode, electrodeposition, electro-oxidation, Methyltrimethoxysilane
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