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Electro-oxidation of alcohols using carbon supported gold, palladium catalysts in alkaline media

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Abstract:
Mono and binary Pd-Au based catalysts were synthesized using the NaBH4 assisted ethylene glycol reduction method. The catalysts were supported on Vulcan XC 72 carbon black and denoted as Pd/C, Au/C, Pd(Au/C) and Pd-Au/C co-reduction. Pd:Au composition was maintained at 1:2 ratio. XRD profiles confirmed the face centered cubic crystal structure of Pd and Au. The average particle size for Pd/C, Au/C, Pd(Au/C) and Pd-Au/C co-reduction is 5 ±0.6 nm, 22 ±0.7 nm, 17 ±0.4 nm and 6 ±0.2 nm, respectively. The catalysts showed activity towards the oxidation of alcohols (methanol, ethanol, ethylene glycol and glycerol) in alkaline media. Cyclic voltammograms indicated that methanol and ethanol oxidation were more favoured on Pd/C than on Au/C catalysts. It was also noticed that the incorporation of Pd on Au, that is on Pd(Au/C) and Pd-Au/C co-reduction, enhances the onset potential for the oxidation of ethylene glycol and glycerol. When comparing all alcohols studied, it was observed that the maximum current density for the oxidation of ethylene glycol was highest for all catalysts at 54.4, 41.4, 39.8 and 12.1 mA/cm2 on Pd-Au/C co-reduction, Au/C, Pd(Au/C) and Pd/C, respectively. Pd-Au/C co-reduction showed better ADAFC performance under passive conditions as compared to Pd(Au/C) with glycerol and ethylene glycol at 8.34 and 8.46 mW/cm2 respectively, and 0.5 mgPd/cm2. Pd-Au/C cored is a more stable and poisoning tolerant catalyst for ethylene glycol and glycerol oxidation.