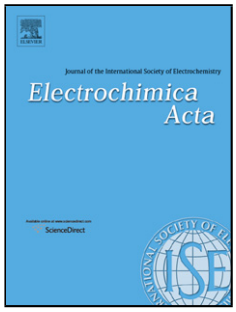

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CO_2 reduction to alcohols in a polymer electrolyte membrane co-electrolysis cell operating at low potentials

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Highlights

- Low temperature co-electrolysis can provide an effective route for CO_2 recycling
- Low temperature CO_2 reduction to alcohols occurs at high voltage efficiency (~90%)
- Ru-based electrocatalysts show enhanced current efficiency for CO_2 reduction
- CO_2 electroreduction is strongly promoted by the increase of cell temperature
- Alcohol formation is maximized at 1.25 V cell voltage in a co-electrolysis system

ABSTRACT

The electrocatalytic reduction of CO_2 to alcohols was investigated in a co-electrolysis cell based on a solid polymer electrolyte. PtRu/C and Ru/C catalysts were used in gas diffusion cathodes for the reduction of humidified CO_2. An $IrRuO_x$ catalyst was used for the oxygen evolution from liquid water at the anode. This electrochemical reactor employed a perfluorosulfonic acid membrane electrolyte separator (Nafion®) and it was operated in a temperature range from 30°C to 95°C. The cathode catalysts were characterized by well-dispersed metal nanoparticles (2 nm mean particle size) on a carbon black support. Electrochemical polarization tests were carried out in the presence of CO_2 or with humidified inert gas for comparison. The results evidenced that direct CO_2 reaction on the catalysts surface was essentially occurring at low cell voltages (< 1.6 V), whereas the occurrence of water splitting (hydrogen evolution) was largely prevailing at high cell voltages. Methanol for the