

## Electrocatalytic oxidation of Methane in an acidic electrolyte using PdMn/C-ITO electrocatalysts synthesized by sodium borohydride reduction Process

Júlio Nandenha, Jessica Yumi Yamashita, Eric Hossein Fontes, Fábio Coral Fonseca, Almir Oliveira Neto  
Energy and Nuclear Research Institute – IPEN-CNEN/SP  
Contact e-mail: ericfisico@gmail.com

**Keywords**

PdMn/C-ITO electrocatalysts,  
Electrochemical Oxidation of  
Methane, Acid Medium,  
Sodium Borohydride Reduction  
Process

**Impact statement**

This work aims at critical issues concerning some of the main technological and scientific challenges towards the use of natural gas in fuel cells.

**Highlights**

The research topics are focused in a technology: proton exchange membrane fuel cell (PEMFC). The main topics to be studied are: a) anodes for efficient electro-oxidation of methane; b) membranes for high-temperature PEMFC; c) high performance electrochemical catalysts for methane oxidation for the electricity generation and products of high value trades.

**Abstract**

Pd/C-ITO and PdMn/C-ITO electrocatalysts with different atomic ratio (90:10, 70:30 and 50:50) were synthesized by borohydride reduction method and characterized by X-ray diffraction, Transmission electronic microscopy and electrochemical studies (cyclic voltammetry). The electrochemical studies showed that PdMn(50:50)/C-ITO had superior performance for electrochemical oxidation of methane in an acidic electrolyte at 25 °C compared to others electrocatalysts prepared. The experiments in a single DMEFC also showed that the PdMn(70:30)/C-ITO electrocatalyst exhibited higher performance for methane oxidation in comparison with Pd/C-ITO, PdMn(90:10)/C-ITO and PdMn(50:50)/C-ITO electrocatalysts. These result indicated that the addition of Mn to Pd favor the electrochemical oxidation of Methane in acid medium, where this effect could be attributed to the synergy between the constituents of the binary electrocatalysts or to electronic modification of Pd atoms by the neighboring Mn atoms as the proximity of Pd and Mn atoms on the surface of the C-ITO (bifunctional mechanism - the presence of Pd and Mn oxides species).