Hardwired for success: Ni supported CeO_2-Sm_2O_3 nanowires as a super stable catalyst for ethanol steam reforming

Thenner S. Rodrigues[1], Arthur B. L. de Moura[1], Felipe Anchieta e Silva[1], Eduardo G. Candido[1], Vanderlei S. Bergamaschi[1], João C. Ferreira[1], Marcelo Linardi[1], Fabio Coral Fonseca[1]*

1- Instituto de Pesquisas Energéticas e Nucleares, IPEN-CNEN, São Paulo/SP, 05508-000, Brazil
*fabiocf@usp.br

Key Words: *nanowires, cerium oxide, ethanol steam reforming*

CeO_2-based nanomaterials have been extensively employed in catalysis and industry, showing excellent performances towards a variety of applications. In the past few decades, great developments have been reported associating the properties of nanostructured CeO_2 with its catalytic performances. Thus, an intense research in this field have been performed in order to increasingly improve the performances of these nanomaterials such as the precise control over their structures, morphologies, compositions, among others. We propose herein, the synthesis of a novel well-defined Sm_2O_3-doped CeO_2 nanowires decorated with nickel nanoparticles as a novel catalyst with outstanding performance towards ethanol steam reforming (ESR).

In order to address these challenges, we were inspired by a well-established hydrothermal method for the synthesis of CeO_2 nanowires. Herein, through simple modifications in the original protocol allowed us the obtaining in high yield (97%) extremely well-defined CeO_2-Sm_2O_3 nanowires exhibiting uniform distributions in lengths and diameters. XRD results (Figure 1A) suggested the introduction of Sm species into the CeO_2 crystal lattices, in which the quantitative $Sm^{3+}_{(aq)}$ conversion achieved 10 mol%, as corroborated by ICP-OES analysis. The resulting CeO_2-Sm_2O_3 nanowires were then employed as support for the Ni incorporation (1 wt%) by a wet impregnation approach, and the obtained catalyst (Figure 1B) was evaluated towards the ESR displaying an exceptional stability even after 100 hours of process at 550 °C. More specifically, 100 % of ethanol conversion was observed with the formation of only H_2 and CO_2 (ESR products) and CO and CH_4 as byproducts (both in low concentrations), indicating a good selectivity for ESR compared to the most recent literature. The characterization data for the Ni/CeO_2-Sm_2O_3 nanowires after catalytic experiment (Figure 1C) indicated that, even after 100 hours at 550 °C, no loss of shape was observed as well as no carbon structures formation justifying the exceptional observed stability.

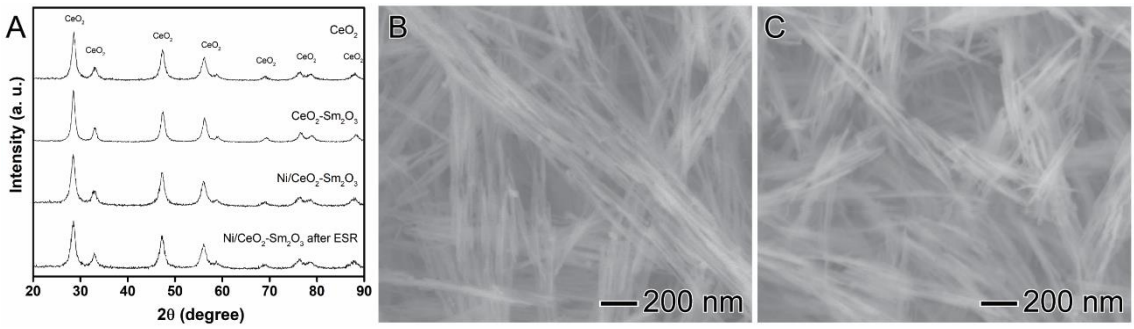

Figure 1. (A) XRD profiles for the synthetized CeO_2-based nanoparticles and SEM images for the Ni/CeO_2-Sm_2O_3 catalysts (B) before and (C) after 100 hours of ethanol steam reforming process at 550 °C.