Ni-based catalysts supported onto hazelnut shells-derived hard carbons for H_2 and CNM production

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In the context of the challenges we are facing today for energy transition, producing H2 CO_x-free seems to be one of the best solutions. Catalytic methane decomposition (CMD) leads to the production of H_2 and carbonaceous nanomaterials (CNMs) with high value in different industrial applications. Ni-based and Ni-promoted catalysts are well documented in literature and seems to be the best option for both H_2 production and carbon growth. [1,2]

In this study Ni, NiFe and NiCu catalyst supported onto hard carbon materials derived from hazelnuts shells, were prepared, characterized and tested to producing hydrogen and high quality carbon nanomaterials at the relatively low temperature of 700 ºC.

Tests and results The catalytic tests were conducted using a thermobalance. Before reaction, the samples was reduced in situ 10 min using 200 Nml/min H_2-500 Nml/min N_2 at 700 ºC. The reaction was carried out at 700 ºC for 6h, feeding a total flowrate of 700 NmL/min (100 H_2/200 CH_4/400 N_2) at atmospheric pressure.

The results in **Figure 1** indicate that the higher carbon productivity was attained by the Ni catalyst (1.99 g_{carb}/g_{met}·h) followed by the NiFe (1.39 g_{carb}/g_{met}·h) and NiCu (1.01 g_{carb}/g_{met}·h). However, both bimetallic catalysts present a lower deactivation rate than the Ni catalyst, maintaining a high activity after six hours of reaction. In terms of morphology and quality of the carbonaceous products obtained **(Figures 1a and 1c)**, the NiCu catalysts is the best material to obtain homogenously CNFs **(figure 1c)** with a high grade of graphitization (ID/IG= 0.34) **(figure 1b).** In spite of the low temperature, the activity of all the catalysts was quite significant.

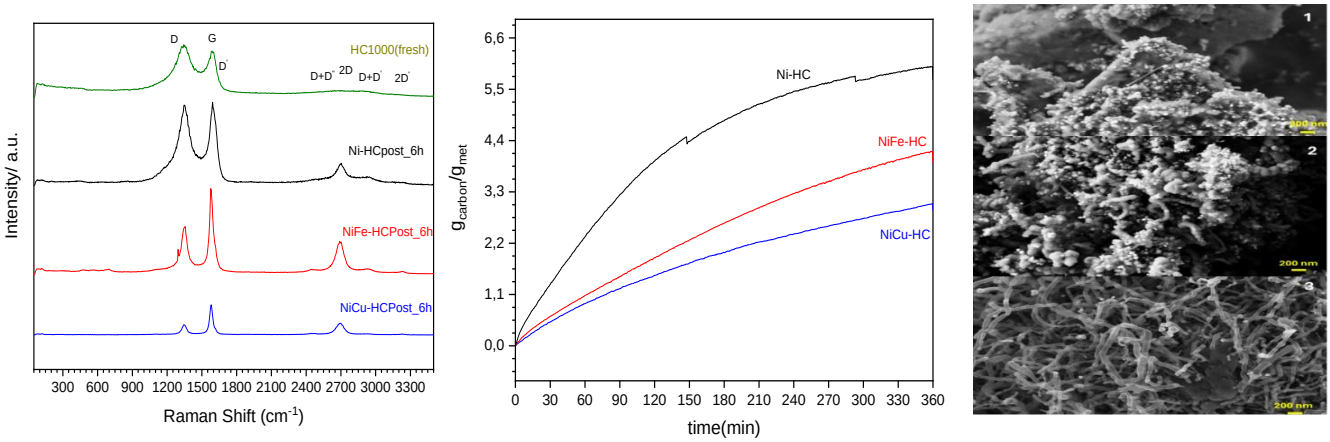

Figure 1 a) Raman spectra of CNMs **b)** Evolution of Carbon concertation **c)** SEM images post reaction: **1**.NiHC **2**.NiFeHC **3**.NiCuHC

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References

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2) S. E. Schoemaker et al., Mater. Adv., 2024, 5, 4251.

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