Offer of internship at Poitiers Institute of Chemistry (IC2MP ; http://ic2mp.labo.univ-poitiers.fr/), France

Duration: 5 months from february 2019 or before

Required level of education : 5th year of university (end of master degree in France ; end of graduation in Brazil)

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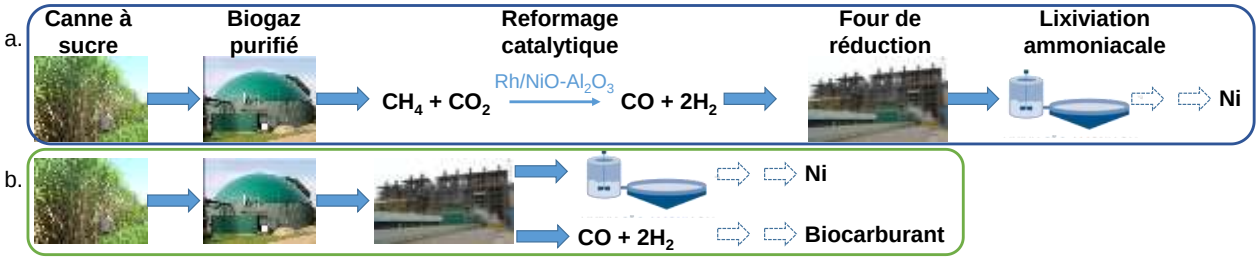
Catalytic performances of Ni-based smectites.

The Caron process, which involves reduction roasting of the ore in Nichols Herreshoff type kilns followed by ammonia leaching of reduced ore, is one of the ways in which **nickel carbonate is produced from laterite ore**. Currently, the reducing atmosphere used in this classical process to reduce the ore is a mixture of H_2 and CO generated by the combustion of fuel oil and/or petcoke with oxygen-deficient air. In a previous study, we developed a $Rh/NiO/Al_2O_3$ catalyst in order to convert by catalytic dry reforming reaction energy-cane-based biogas constituted of methane and carbon dioxide into a mixture of hydrogen and carbon monoxide which is then introduced in the metallization furnace (Scheme 1a). The replacement of fossil fuel by bioresources in the metallization step of laterite Ni via the generation of syngas improves the sustainability of the Caron process.

The goal of the new study is to limit the number of steps of the process by introducing the biogas directly inside the kiln where the reduction of the ore and the generation of syngas ($CO + 2\ H_2$) would occur simultaneously (Scheme 1b). The preliminary results showed a relationship between the lateritic ore composition, the content of Ni and the catalytic performances. However other parameters like the presence of additional cations in the ore can also influence the catalytic activity. These promising results pave the way of a large investigation field in which knowledges in the crystallochemistry of Ni ores and characterization of solid surface are crucial.



Schema 1 : Utilization of biomass in the reduction process of lateritic ores for Ni production (a) with intermediary dry reforming of methane; (b) par direct reduction of the ore with biogas

The work of the master student will be developed in 2 teams of the IC2MP: HYDRASA team which already investigated the crystallochemistry of the laterite ores from Ni production site located at Niquelândia in Brazil [1,2]; SAMCat team which performed the preliminary catalytic tests in dry reforming reaction of the same ores. In the silicated ores from the Niquelândia site, Ni is associated to smectite-type clay minerals which may contain up to 25 wt% Ni located inside the structure (octahedral layer) or as exchangeable cation in the interlayer space.

The main axis of the study will deal with the relationships between the catalytic performances and the Ni loading and its position in the structure by using X-ray diffraction and FTIR spectroscopy. The utilisation of model clay materials having different cationic exchange capacity will enable the understanding of the role of the Ni loading. A second axis consisting in the improvement of the catalytic activity by post-treatments of the Ni ore is also envisaged

References

[1] MANO, E.S., CANER, L., PETIT, S., CHAVES, A.P. and MEXIAS, A.S. 2014. Mineralogical characterization of Ni-bearing smectites from Niquelândia, Brazil. Clays and Clay Minerals, 62, 324–335.
[2] MANO, E.S., CANER, L., PETIT, S., CHAVES A. P. AND MEXIAS, A.S. Ni-smectitic ore behaviour during the Caron Process. Accepté avec revision. Hydrometallurgy.