HETEROGENEOUS CATALYSTS FOR HYDROGEN STORAGE IN FORMATES AQUEOUS SOLUTION

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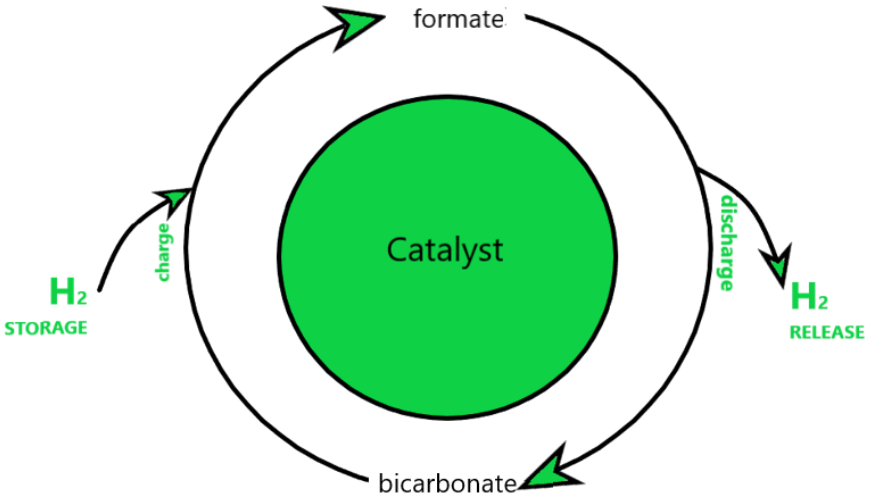
Scientists are paying a lot of attention to hydrogen and its carriers in order to develop energy storage technologies at different scales. The investigation of novel hydrogen carriers that can release hydrogen at nearly-ambient conditions has attracted attention in recent years. Formic acid salts HCOOM ($M = Li^+, Na^+, K^+, Cs^+, NH_4^+$), prepared through catalytic hydrogenation of bicarbonate ions, are one of the interesting materials that have been suggested. They may represent an alternative method for safely and economically storing and transporting large quantities of H_2, releasing it when needed in the presence of a catalyst at temperatures below 80°C.



There is little information now available on the stability of the catalysts proposed (most often Palladium-based) to release hydrogen from formates. According to a careful examination of the literature, most of the investigated heterogeneous catalysts , require frequent reactivation. Commercial Pd/C catalysts for formate dehydrogenation have been demonstrated to work effectively up to fifteen reversible cycles in HCOOK-$KHCO_3$ system.

Accordingly, the goal of this PhD is to identify stable catalytic Pd/support systems (carbonaceous materials, oxides) that may guarantee hydrogenation/dehydrogenation rates that are suitable for commercial applications. Semiconducting oxides will receive extra attention in the identification of supports since their employment would allow for the adoption of an easier production method, such as photodeposition of the noble metal from solutions containing its salts, as an alternative to impregnation.

In a circular economy-based strategy, the potential for employing solutions containing noble metals from leaching operations of waste materials, such as, for example, used catalytic converters or discarded electronic boards, will also be assessed. The activity will also be expanded to include a study of the potential applications of additional noble metals, such as Ru, Pt, and PdZn or PdAg alloys, deposited on appropriate substrates in the catalytic system preparation.

Marcella Calabrese, PhD student XXXVII cycle, July 2022