Development of Co-Pt based tandem catalysts for CO_2 hydrogenation

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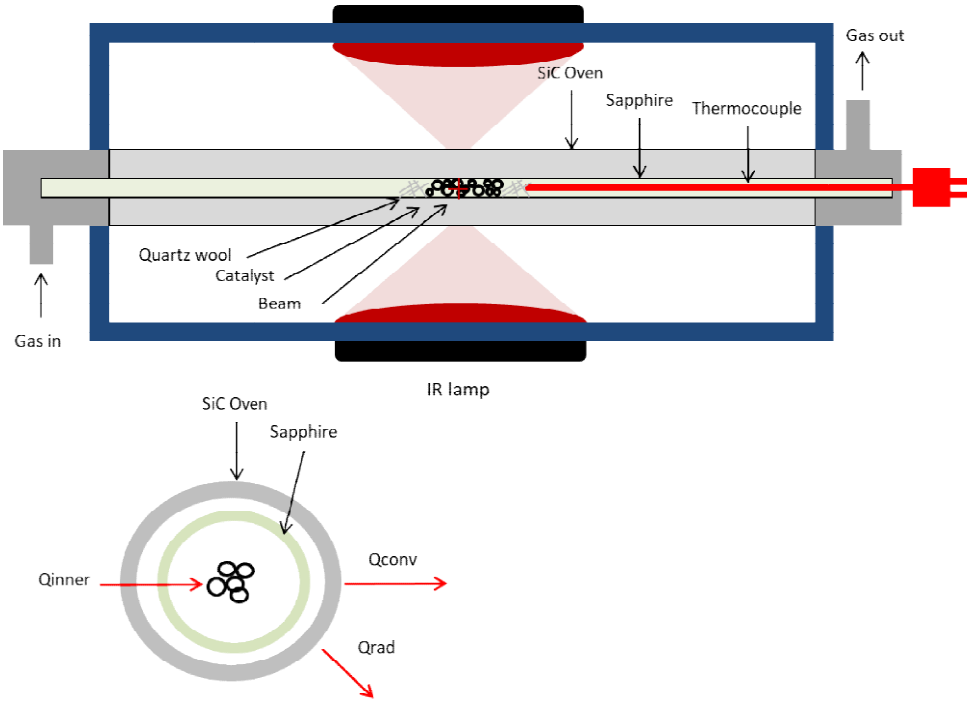

In recent years, tandem catalysts have garnered a lot of interest for their ability to carry out subsequent chemical transformation and thereby reducing the energy consumption for separation and purification steps[1]. A combination of Pt as catalyst for the reverse water gas shift reaction and Co for the Fischer-Tropsch synthesis have recently been demonstrated as promising candidates for the tandem CO_2 hydrogenation to light olefins[1,2]. However, this approach relies heavily on the separation of well-defined Co and Pt nano-particles by a mesoporous silica shell in a core-shell. Simpler approaches relying on physical mixing of Co- and Pt-based catalysts[2] or the impregnation of a support with Co and Pt[3] usually lead to the formation of either CO or CH_4. Despite the fact that a large number of studies on Co-Pt-based catalysts for the CO_2 hydrogenation exists, there is surprisingly few information showing the catalytic properties of specific Co-Pt alloys.

Herein, we report the development of a fast-heating device for the in situ characterization with X-ray diffraction (XRD) and X-ray absorption spectroscopy (XAS) under elevated temperature, pressure and controllable gas atmosphere. Via in situ synchrotron-based XRD, we demonstrate that depending on the impregnation order of Co and Pt loaded onto amorphous silica spheres exhibit vastly different sintering and alloying properties behavior. Combining these results with catalytic tests and transmission electron microscopy studies is expected to provide new insights into the Co-Pt system in regard to developing a tandem catalyst for the CO_2 hydrogenation.

[1] E.Gioria, L. Duarte-Correa, N. Bashiri, W. Hetaba, R. Schomäcker, A. Thomas, *Nanoscale. Adv.* **2021**.
[2] C. Xie, C. Chen, Y. Yu, J. Su, Y. Li, G.A. Somorjai, P. Yang *Nano Lett.* **2017**, 17, 3798-3802.
[3] S. Kattel, W. Yu, X. Yang, B. Yan, Y. Huang, W. Wan, P. Liu, J.G. Chen., *Angew. Chem. Int. Ed.* **2016**, 55, 7968-7973.