One step synthesis of PtCo/TiO$_2$ catalysts by flame spray pyrolysis for selective hydrogenation of furfural to furfuryl alcohol

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Abstract: Furfural is a biochemical derived from lignocellulosic biomass that can be used to produce furfuryl alcohol (FA), the raw material of several products such as lysine, furan resins, lubricant oils, and ascorbic acid. The liquid-phase selective hydrogenation of furfural to FA was carried out in a batch reactor at 323 K and 20 bar H$_2$ using Pt/TiO$_2$ (0.5 wt% Pt) and PtCo/TiO$_2$ (0.5 wt% Pt and 0-0.2 wt% Co) synthesized by one-step flame spray pyrolysis (F) and impregnation (I) methods. The monometallic (F)-Pt/TiO$_2$ and (I)-Pt/TiO$_2$ exhibited similar furfural conversion at ~83-85% after 2 h reaction time but the FA selectivity of the (F)-Pt/TiO$_2$ was much higher (95%) than the (I)-Pt/TiO$_2$ (71.5%). The FA selectivity was increased with increasing Co loading on the impregnation-made catalysts without changes of furfural conversion. Nevertheless, the flame-made catalysts showed much lower amounts of tetrahydrofurfuryl alcohol (THFA) and other by-products than the impregnation-made ones. The catalyst performances were correlated to the surface characteristics of Pt and PtCo as determined by H$_2$-temperature-programmed reduction and infrared spectroscopy of adsorbed CO (CO-IR).

Keywords: Pt-Co; Bimetallic catalysts; Furfural hydrogenation; Flame spray pyrolysis