

## Development of In-X bimetallic catalysts for enhanced CO<sub>2</sub> hydrogenation to methanol

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Recent literature has shown indium oxide to be a highly selective catalyst for methanol synthesis from CO<sub>2</sub>.<sup>1</sup> Further work has shown that enhanced activities can be achieved by modifying the indium oxide catalyst with other metals, such as Pd.<sup>2</sup> In the present work, a range of bimetallic In-Pd and In-Ni catalysts were synthesized and tested under CO<sub>2</sub> hydrogenation conditions. Catalysts with intermediate compositions had increased activity and selectivity towards methanol compared to the monometallic systems. In particular, In<sub>2</sub>Pd/SiO<sub>2</sub> showed superior methanol yields of over 6 μmol MeOH/g<sub>InPd</sub>/sec while maintaining 58% selectivity towards MeOH. Ex situ x-ray diffraction of this catalyst confirms the formation of an In-Pd alloy; however, operando x-ray absorption spectroscopy shows that the catalyst is more complex with both an In-Pd alloy phase and indium oxide phase present. Further characterization is required to fully understand the interactions between these phases under reaction conditions.

1. Martin, O., Martin, A.J., Mondelli, C., Mitchell, S., Segawa, T.F., Hauert, R., Drouilly, C., Curulla-Ferre, D., Perez-Ramirez, J. *Angewandte Chemie*. 2016, 55, 6261-6265.
2. Ye, J., Liu, C., Mei, D., Ge, Q. *J. Catal.* 2014, 317, 44-53.