Zirconium-Assisted Activation of Palladium Boosting Syngas Production by Methane Dry Reforming

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Dry Reforming of Methane (DRM) has been proposed as a promising technology to reduce and utilize CO_2. This apparently simple reaction transforms two climate relevant greenhouse gases (CO_2 and CH_4) into useful syngas (CO and H_2), which can be used for fuel production via Fischer-Tropsch synthesis. [1] The major drawback of this technology, especially in terms of upscaling for industrial usage, is the deactivation of the catalyst material (normally Ni-based catalysts) by carbon deposition. Therefore, a lot of effort has been made to develop new coking-resistant materials like Pd doped Ni catalysts. [2] Intermetallic Pd/Zr precatalysts show strongly improved DRM activities relative to pure Pd. In addition to their high activity and relatively low onset temperature, the highly efficient “carbon management” is one of the most interesting aspects of this catalyst. On the one hand, carbon formation is a major aspect to create an active DRM catalyst but on the other hand, the carbon “clean-off” reaction has to be very sufficient to prevent irreversible deactivation by coking. In situ X-ray photoelectron spectroscopy (XPS) experiments, at the synchrotron BESSYII (ISISS beamline) in Berlin, showed that the intermetallic Pd/Zr catalyst fulfills both of this requirements and is therefore an interesting catalyst material to produce syngas. As a crucial step of this reaction dissolved carbon in the form of Pd_xC has been identified. It plays an important role because the atomic carbon can diffuse to the phase boundary and sufficiently react to the DRM products without any coke formation. [3]

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[2] B. Steinhauer, M. R. Kasireddy, et al., Applied Catalysis A: General, **366**, 333-341 (2009)
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