One for all: Iron as active metal, promoter and inhibitor in solid catalysts

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Iron plays multifold roles in heterogeneous catalysis. Most prominently, it is the main ingredient of the industrial ammonia synthesis catalyst in form of α-iron.[1] Recently, the formal back-reaction ammonia decomposition gained interest due to ammonia's great potential as a hydrogen storage molecule. Iron-based alloy catalysts have been shown to be highly active and can be synthesized with high metal loadings of around 70%.[2] The major role of the alloying element cobalt seems to be the suppression of nitridation of the α-iron.

In other metal catalyst, iron is present in form of an oxide supporting another active metal such as a palladium. With such noble metal, iron oxides easily form strong metal support interactions upon partial reduction.[3] These were shown to be strongly promoting the CO oxidation reaction, but suffer from fast deactivation.[4]

Finally, bulk iron-based mixed oxides of the spinel and perovskite types can be employed in oxidation catalysis as bulk catalysts. The role of iron was found to be ambiguous as low amounts can indeed promote reaction such as 2-propanol oxidation to acetone.[5] However generally and in the work of the CRC/TRR 247 "Heterogeneous Oxidation Catalysis in the Liquid Phase"[6] much more often, an inhibiting role in thermal and electrocatalytic reactions was found for iron addition to cobalt oxide catalysts. However, the iron-cobalt mixed spinel system turned out to be an interesting prototype mixed oxide catalysts to study the effects of composition,[7] mesostructure,[7] nano-segregations[8] and porosity[9] on the catalytic performance.

The presentation will give an overview on our recent research activities using solid iron catalysts and discuss the wide range of applications of iron materials in the thermal and electrocatalysis highlighting the similarities and differences between the various catalytic reactions.

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