

Quantifying the promotion of Cu catalysts by ZnO for methanol synthesis. - DTU Orbit (09/11/2017)

Quantifying the promotion of Cu catalysts by ZnO for methanol synthesis.

Promoter elements enhance the activity and selectivity of heterogeneous catalysts. Here, we show how methanol synthesis from synthesis gas over copper (Cu) nanoparticles is boosted by zinc oxide (ZnO) nanoparticles. By combining surface area titration, electron microscopy, activity measurement, density functional theory calculations, and modeling, we show that the promotion is related to Zn atoms migrating in the Cu surface. The Zn coverage is quantitatively described as a function of the methanol synthesis conditions and of the size-dependent thermodynamic activities of the Cu and ZnO nanoparticles. Moreover, experimental data reveal a strong interdependency of the methanol synthesis activity and the Zn coverage. These results demonstrate the size-dependent activities of nanoparticles as a general means to design synergetic functionality in binary nanoparticle systems.

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