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Electron Microscopy Studies of Supported Metal Catalysts Used for Conversion of Synthesis Gas

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Synthesis gas, a mixture of CO and H_2, can be produced from any carbon-containing feedstock such as natural gas, coal or biomass as well as from hydrogenation of CO_2. Supported metal catalysts are used for synthesis gas conversion to alternative fuels and chemicals. Here we present electron microscopy studies of size and distribution of nanoparticles in supported Co, Cu and Fe catalysts and the impact on performance.

First, for supported cobalt catalysts we report the effects of particle size and distribution to arrive at high activity and stability for conversion of synthesis gas to higher alkanes [1].

Second, for copper catalysts large effects of nanoparticle distribution on stability in methanol synthesis are apparent [2]. In Figure 1 the vastly different nanospatial distributions of two SBA-15 supported Cu catalysts is shown with tremendous impact on their respective stability for the methanol synthesis.

Third, favorable effects of a uniform distribution of Fe nanoparticles on an alpha-alumina or carbon nanofiber support for FTO (Fischer Tropsch to lower Olefins) performance are presented [3]. In Figure 2 different distributions and related tendency for carbon lay-down are shown.

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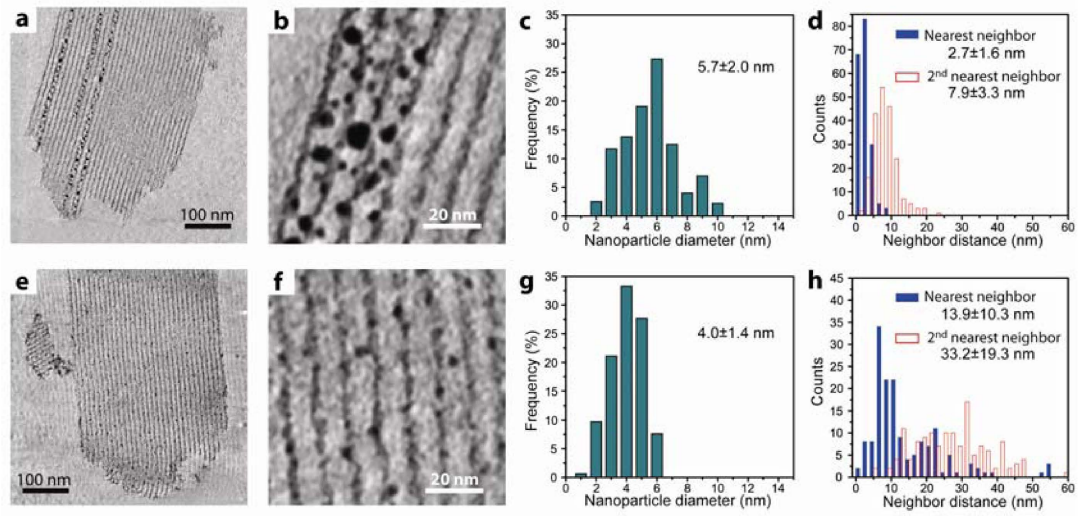

Figure 1. Quantitative electron tomography results for CuZn/SBA-15 catalysts. The figure includes cross-sections through the 3D-reconstructed tomograms (a-b and e-f), surface-weighted Cu nanoparticle size histograms (c,g) and surface-to-surface nearest-neighbors distance histograms (d,h) for the Cu particles in the CuZn/SBA-15 catalysts calcined under a flow of 2%NO/N2 (a-d) or a flow of N2 (e-h), and subsequently reduced in 20%H2/N2.

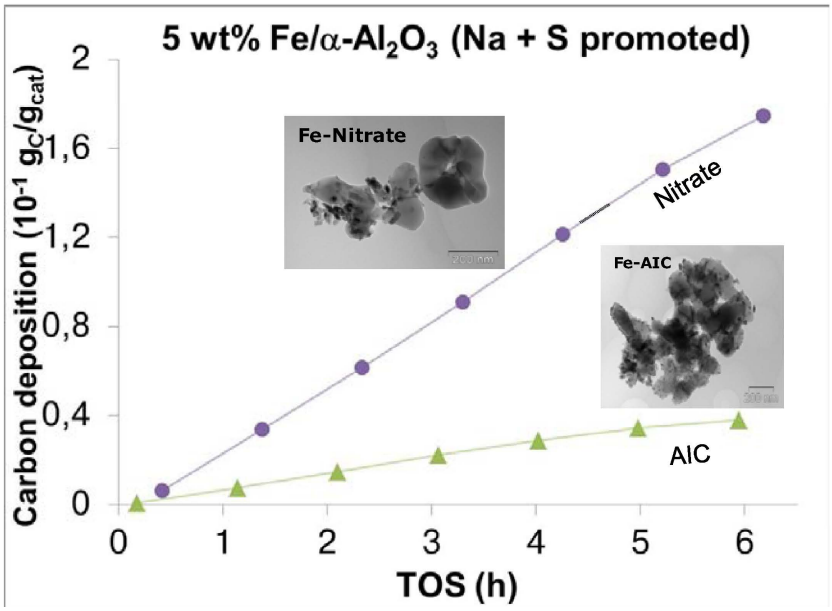

Figure 2. Iron nitrate precursor leads to clustered iron nanoparticles whereas ammonium iron citrate (AIC) leads to more uniform distribution and related lower rate of carbon formation.

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