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TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע״ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar

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Room #6

Nickel at the interfacial sites between thin $MgAlO_x$ and ZrO_2 identified as a highly active and stable catalyst for DRM

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PhD Mid-Seminar

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Dry reforming of methane (DRM) is receiving significant attention as a possible path to convert large amounts of the two major anthropogenic greenhouse gases, methane and carbon dioxide, into syngas and in-turn to value-added chemicals. Nickel (Ni)-based catalysts have been identifying as the most promising candidates for DRM. However, if the Ni particles are not sufficiently stabilized, they tend to deactivate through sintering under the high reaction temperature. This is due to a low Tammann temperature of Ni (590 ℃) and the formation of a carbon film on the catalyst surface. It was recently shown by our group that the Ni particles can be stabilized by introducing an intermediate $MgAlO_x$ layer in the between the Ni and the underlying ZrO_2. This so-called hierarchical support is aimed at balancing the complex interactions between the metal and the support.

In my research I investigate the effect of the Ni location of the support on DRM activity and selectivity. Specifically, I will show that the spatial distribution obtained for Ni loading between 0.2% wt and 2.2% wt dramatically affects the metal-support-interactions and in-turn catalytic performance in DRM. To demonstrate that I used a range of analytical techniques including high-angle annular dark-field scanning transmission electron microscopy and energy dispersive X-ray spectroscopy (HAADF-STEM-EDS), temperature programmed reduction (TPR), X-ray photoelectron spectroscopy (XPS) and more. The results for material characterization were cross-referenced with catalytic results and the conclusions validated by theoretical model for hierarchical catalysts with different Ni locations developed using Density function theory (DFT). Using this combined approach, we identified that Ni located at interfacial support sites is more active and more stable for DRM.