

## Executive Summary

Project title: **Synthesis and Characterization of  $\text{WO}_3/\text{ZrO}_2$  mixed oxide nanoparticles for possible applications as a catalyst in Isobutane alkylation**

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- Pure zirconia at ambient conditions exists in three temperature dependent polymorphs: stable monoclinic phase (below 1170 °C), metastable tetragonal phase (between 1170 and 2370 °C) and cubic phase (above 2370 °C). Reports on isobutane alkylation studies shows that the zirconia and  $\text{WO}_3$  mixed oxides acts as good solid-state catalysts in alkylation process. Also, this particular property is phase dependent. Out of the three phases tetragonal zirconia is found to exhibit better catalytic action than the other two phases.
- In this context, we analysed the effect of certain synthesis parameters on tetragonal phase stabilization in zirconia nanocrystals. For this zirconia nanocrystals have been synthesized using an arrested chemical precipitation method and the influence of different surfactants was analyzed.
- The samples were characterized using X-ray diffraction, HRTEM, SEM, UV-Visible absorption and Micro Raman Studies. The XRD pattern revealed that the samples synthesized using PVP as capping agent are in tetragonal phase.
- The HRTEM and micro Raman studies also confirmed that tetragonal phase is more predominant in the zirconia nanoparticles synthesized using PVP as capping agent. Phase stabilization in zirconia nanocrystals depends on the polymerization rate of tetramers with the hydroxyl ions released by the base. Slow polymerization of tetramers results in formation of ordered structure of zirconium hydroxide which on calcination yields zirconia nanocrystals with dominant tetragonal phase.
- Lower polymerization rate can result in more tetragonal content. Phase analysis in sample synthesized using PVP as capping agent from XRD and Raman, shows that the tetragonal content in the sample is higher than that of synthesized using CTAB as capping agent. This is due to significant reduction in polymerization rate of PVP stabilized tetramers than that of CTAB stabilized one.
- The XRD pattern and micro Raman studies of  $\text{WO}_3$  pattern showed that the samples are in orthorhombic phase. The  $\text{WO}_3$  and zirconia nanoparticles synthesized using PVP as capping agent can be mixed in different proportions for isobutane alkylation.