

# **SBA-15-supported highly dispersed copper catalysts: Vacuum-thermal preparation and catalytic studies in propylene partial oxidation to acrolein**

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SBA-15-supported copper catalysts with high loading of highly dispersed copper species in fully open mesopores were successfully prepared and applied for partial oxidation of propylene with molecular oxygen. The preparation involved simple impregnation of copper nitrate into pristine SBA-15 or the functionalized SBA-15 with hydrophobic mesopores followed by vacuum-thermal treatment. The treatment was found to be a key step to generate small Cu<sub>2</sub>O particles that finally transformed to very small (1-4 nm) metallic Cu particles after hydrogen reduction. The vacuum-heated catalysts exhibited high activity in partial oxidation of propylene with dioxygen and high selectivity of acrolein. The presence of hydrophobic groups on the mesopores of host silica was found beneficial to propylene conversion, acrolein yield and catalytic stability. The catalyst with an optimum loading of copper showed an excellent acrolein yield of 12.3% at 300 °C. In-situ X-ray absorption spectroscopic study showed that the metallic Cu particles in the reduced catalysts got oxidized upon exposure to the reaction gas, and only Cu(I) and Cu(II) species are present under reaction conditions with the fraction of Cu(II) increased with increasing temperature.

Keywords: supported copper catalyst, mesoporous material, high dispersion, propylene partial oxidation, X-ray absorption spectroscopy

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