# Ruthenium-containing Ordered Mesoporous Silica: Promising Catalyst for Reduction of NO by CO



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# INTRODUCTION

- The CO-NO reaction is an important reaction for air pollution control.
- Industrial catalytic converters contain mainly Pt and Rh based catalysts for NO reduction, which are expensive, and Pt demonstrates selectivity to N<sub>2</sub>O, another pollutant.
- The use of Ru, which is more abundant, shows promise and exhibit nearly the same activity as Rh, thereby it could reduce considerably lthe cost of the catalyst.
- Therefore, in this study, Ru-containing various silica (with MCM-41, MCM-48, SBA-15, SBA-3, and MFI structures) and aluminophosphate (with APO-5 structure) catalysts were prepared by different methods.
- The catalysts were characterized by various analytical and spectroscopic techniques, viz., XRD, N<sub>2</sub> sorption, TEM, ED, ICP-AES, etc.
- The activities of these ruthenium-containing catalysts, without any pretreatment, were evaluated for the reduction of NO by CO.
- The effects of various parameters including surface area, pore size and various supports on the catalytic performances with respect to reaction temperature were investigated.
- The performance of RuSBA-15 catalyst showed excellent activity for the reduction of NO by CO as compared with other catalysts.

### XRD patterns of calcined: (a) RuMCM-48; (b) RuMCM-41; (c) RuMCM-41 (50) and (d) Ru/MCM-41



#### TEM and ED images of RuMCM-41 (50)



#### TEM images of : (A) RuMCM-41 and (B) RuMCM-48



### Influence of preparation methods CO conversion and NO conversion [NO(-▲-), CO(-▼-)]RuMCM-41(50), [NO(-Δ-), CO(-∇-)]RuMCM-41, Ru/MCM-41[NO(-o-), CO(-●-)] catalysts.



## Effect of surface area and pore size on catalyst activity of NO reduction by CO : [NO (-▲-), CO (-▼-)]RuMCM-48, [NO(-■-), CO(●)]RuMCM-41



## Thermal stability of ruthenium species in RuMCM-41 (50) for the reduction of NO



#### Effect of CO concentration on the reduction of NO over RuMCM-41(50) [850 ml/min (578 ppm NO (▲) + 1632 ppm CO (▼)], [500 ml/min (581 ppm NO (△) + 870 ppm CO (∇)], [400 ml/min (579 ppm NO (◄),+ 652 ppm CO (►)] catalyst.



#### TEM image and ED Pattern of RuSBA-15





(d) Intensity (a.u) (C) (b) (a) 38 20 22 24 32 26 28 30 34 36 20 (deg.)

> XRD patterns of: (a) RuTS-1; (b) RuCoAPO-5 (c) RuSBA-15; (d) RuSBA-3



NO-CO conversion over various catalysts: [NO(-▲-), CO(-▼-)] RuSBA-15, [NO(-Δ-), CO(-∇-)] RuSBA-3, [NO(-◀-), CO(-▶-)]RuTS-1, [NO(-●-), CO(-○-)]RuCoAPO-5, [NO(-×-)] SBA-15, [NO(-★-)]CoAPO-5, [NO(-★-)] RuTS-1.



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