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Synthesis of TS-1 zeolite nanocrystals with controllable mesoporosity and size

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1. Introduction

TS-1 with the isolated tetra-coordinated titanium has the excellent catalytic properties in many oxidation processes[1]. However the small pore size of TS-1 unfortunanetely hinders the diffusion rates of reactants and products, limiting its performance in industrial catalysis. Hence, much interests has been devoted to the hierarchical architecture of TS-1 with controlled size and porosity on the nanoscale to efficaciously overcome the mass transport limitations[2]. Our study mananged to explore a new method to manufacture the nano-sized hierarchical porous TS-1 without additional template[3].

2. Methods

Mesoporous TS-1 zeolite nanocrystals was synthesized using steam-assist dry gel crystallization method which according to Kirkendall effect[4], the crystallization of TS-1 was controlled by using different ratio of dry gel and H_2O. The physico-chemical properties of the mesoporous nanocrystal TS-1 were investigated by multi-techniques such as XRD, UV-vis, FT-IR, N_2 physisorption , SEM and TEM characterizations.

3. Results and discussion

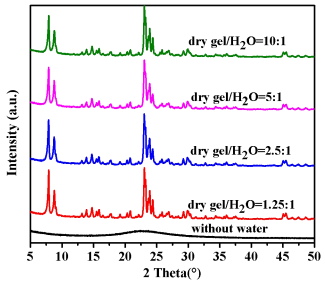

Figure 1. XRD pattern of different ratio of dry gel/H_2O.

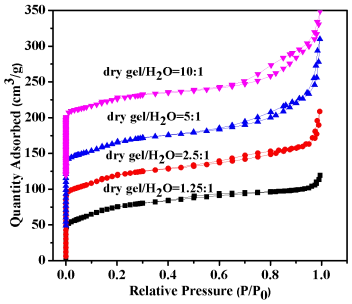

Figure 2. N_2 sorption isotherms of different ratio of dry gel/H_2O.

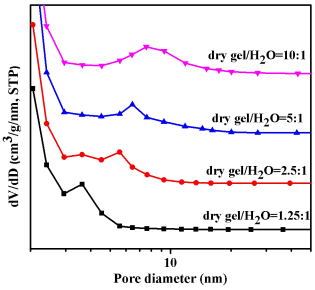

Figure 3. Pore size distribution of different ratio of dry gel/H_2O.

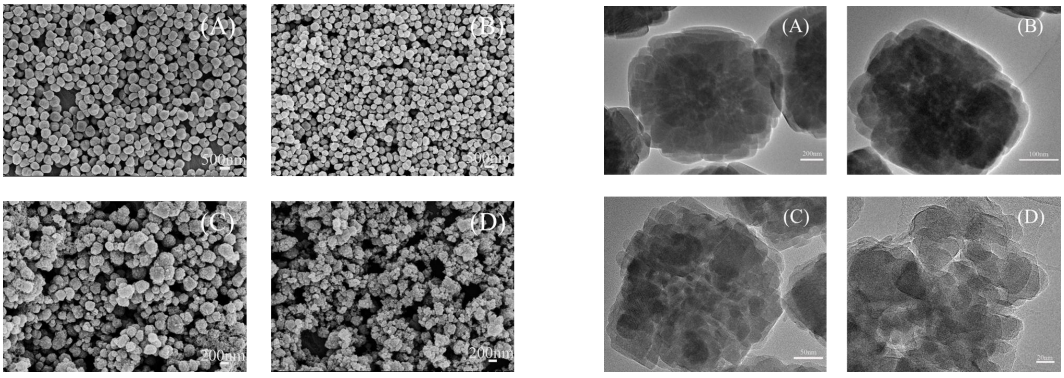

Figure 4. SEM and TEM images of different ratio of dry gel/H_2O((A)1.25:1(B)2.5:1(C)5:1(D)10:1)

4. Conclusions

The Kirkendall effect was utilized to synthesize hierarchically porous TS-1 nanocrystals without the involvement of additional template, the mesopore size as well as the particle size can be easily controlled via different ratio of dry gels and H_2O.The Kirkendall growth method is suitable for lagre-scale synthesis of mesoporous MFI zeolites with very high yields.

References

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Keywords
TS-1; nanocrystal; hierarchical; Kirkendall effect.