

Report 6

Particle Synthesis and Properties of Zeolite  
Catalysts for Synthesis Gas-Gasoline Conversion

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Title: Particle Synthesis and Properties of Zeolite Catalysts for Synthesis Gas - Gasoline Conversion

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Objectives: To form strong particles of zeolite ZSM-5 varieties and other zeolites by direct synthesis techniques, to modify them by ion exchange and thermal treatments for synthesis gas-gasoline and for methanol-gasoline conversions, and to obtain adsorption and catalytic activities as a function of crystal chemistry, morphology, and modifications.

Program to Date: This paper reports on previous work in our laboratories relevant to the project objectives. The parameters, approach, and special problems are summarized on the attached sheets. The first plate of scanning electron micrographs shows the effect of silica reactant source and anion on the morphology of ZSM-5 crystals. The second plate shows the growth of uniform 100 $\mu$ m crystals in large precursor gel particles.

Future Program: Equipment is being acquired to scale up the syntheses of larger batches of the larger crystals produced in various systems to evaluate catalytic activity as a function of the material parameters.

# Objectives

## Particulation during Synthesis

- Fluid bed
- Fixed bed
- Membranes
- Effect on properties

## Delineation of crystallization parameters

- Crystallization curves
- Arrhenius plots
- Isothermal metastable phase transformation diagrams

- Mechanisms of Nucleation,
- Crystallization,
- Crystal Growth

# Parameters

P.T.X-t

## Pressure

Autogenous Only

## Temperature

75 ~ 200° C

## Composition

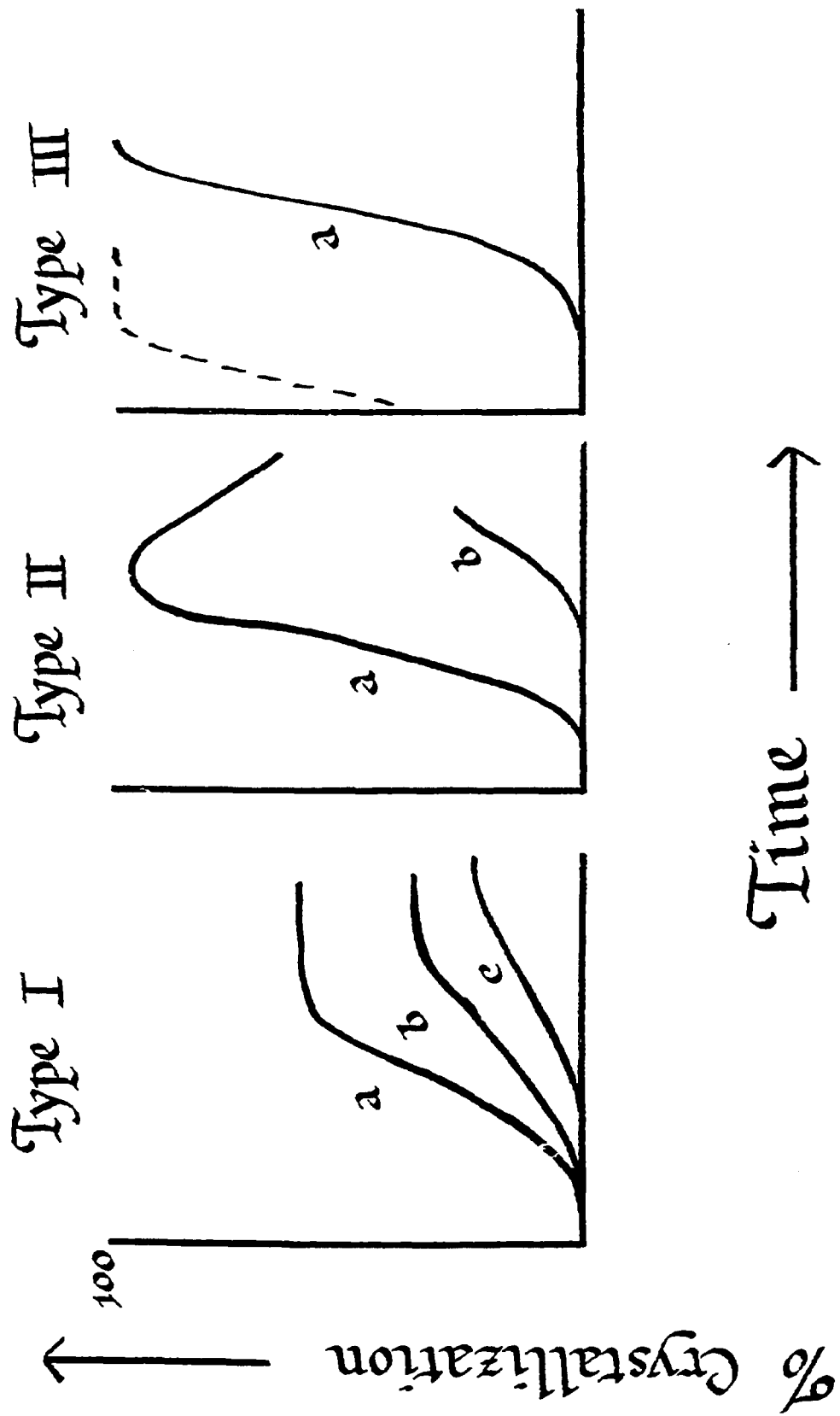
Na	TPA-OH	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	H <sub>2</sub> O	Cl
K	TPA-BR				Br
NH <sub>4</sub>					CO <sub>3</sub>

Reactants:

Aluminate      Ludox  
Reheisgel      Quso

## Time

1 ~ 500 hrs.



# Larger Crystals

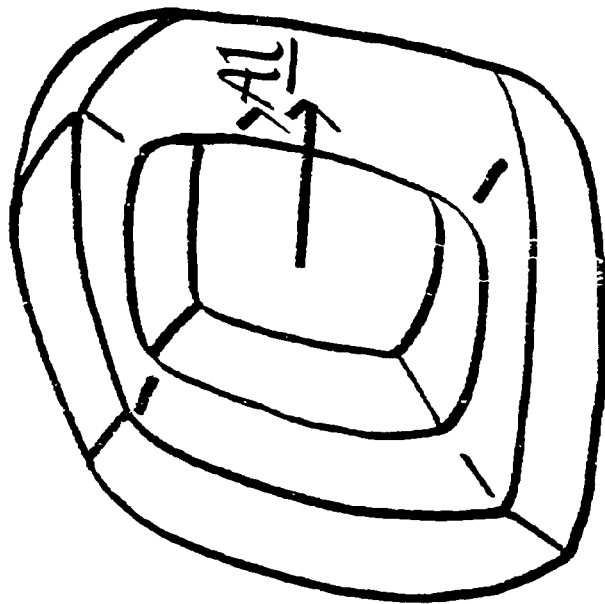
## Working Hypothesis :

- Viscous Batch Composition
- Self-supporting Medium
- Reduction of Nucleation Sites
- Slower rate Nutrient Transfer

# Special Problems

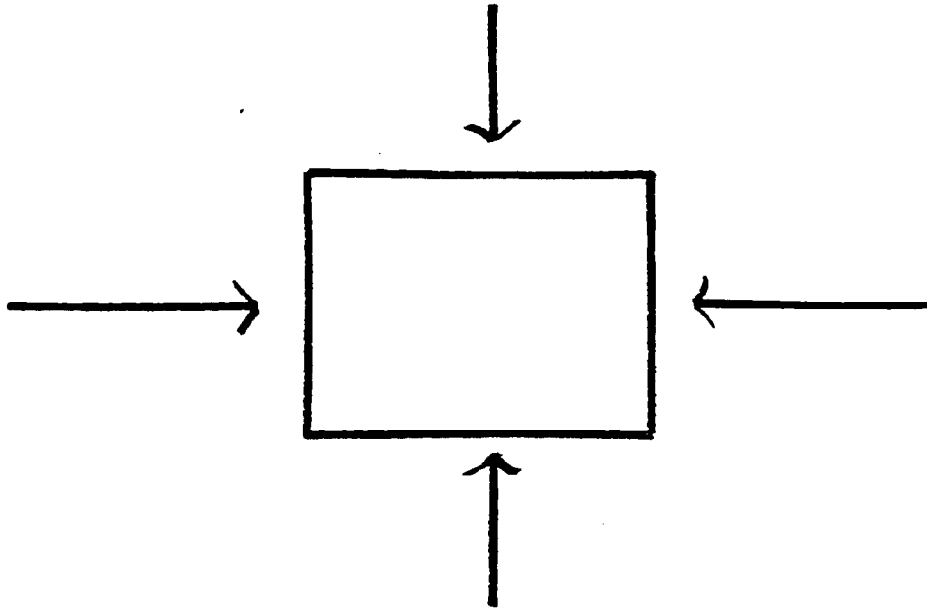
- ◆ Few Scientific Publications
- ◆ Cost
- ◆ Nutrient Dissolution Rates
- ◆ Variable Composition During  
Growth

# Zoned Crystals

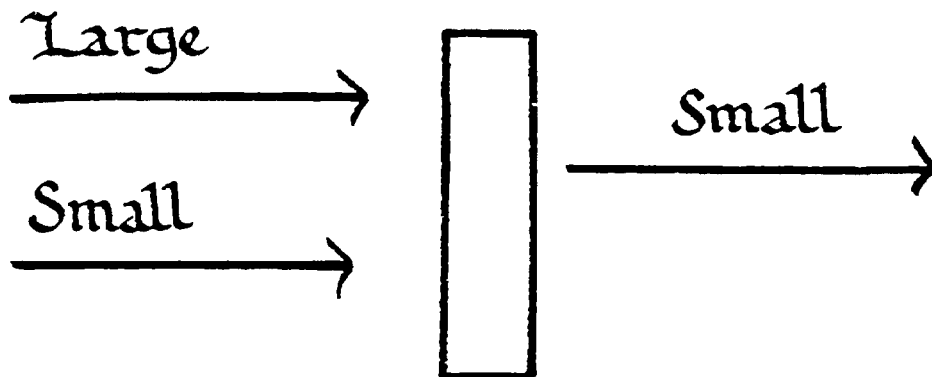




Random Diffusion



Directional Diffusion



# Credits

Glenn W. Dodwell: Mordeinite ·  $MU^{-1}$

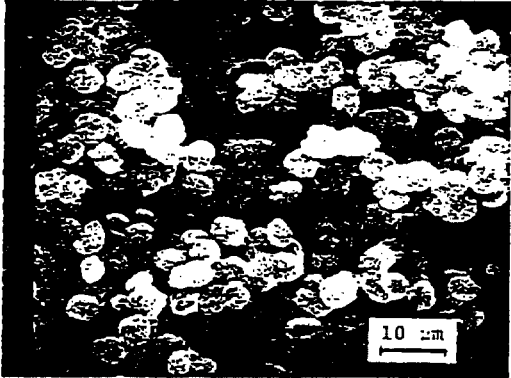
Majid Ghamami:  $MH_4$ -ZSM-5

Ryszard Mostowicz: High ratio  $Me/K_{4,N}$

Ali Paravar : “Silicalite”

Nazanin Shah-Hosseini : “Large”  
ZSM-5 crystals

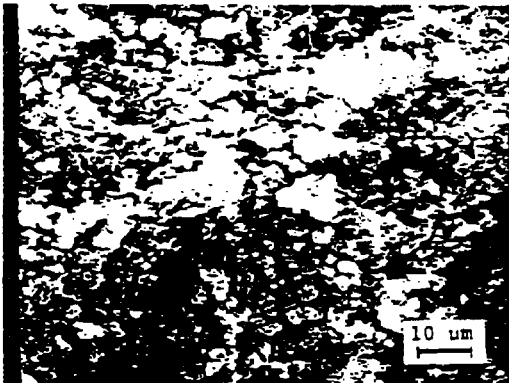
QUSO



LUDOX



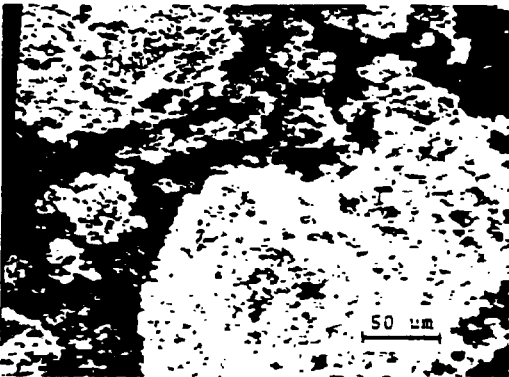
$\text{OH}^-$



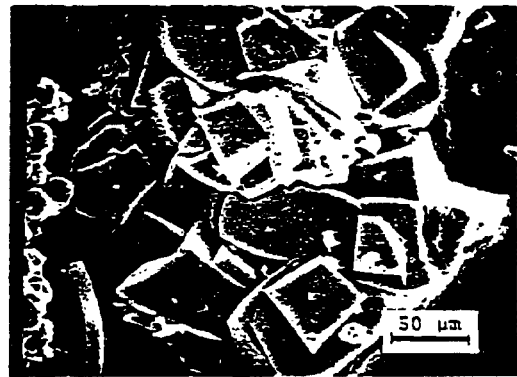
$\text{CO}_3^{--}$



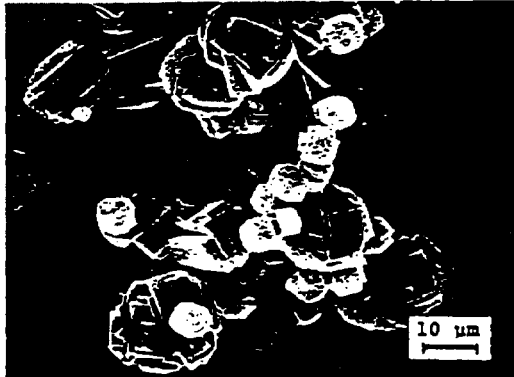
$\text{OH}^-$



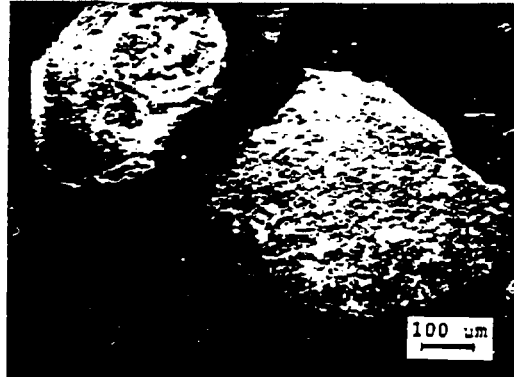
$\text{Cl}^-$



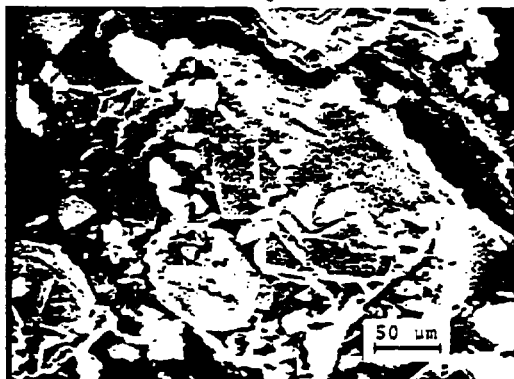
TPAOH



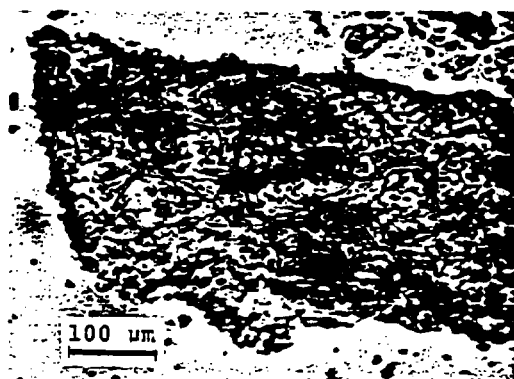
10 hr



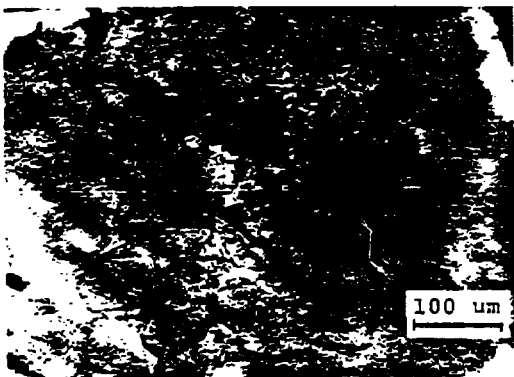
30 hr (SEM)



30 hr



40 hr



48 hr

