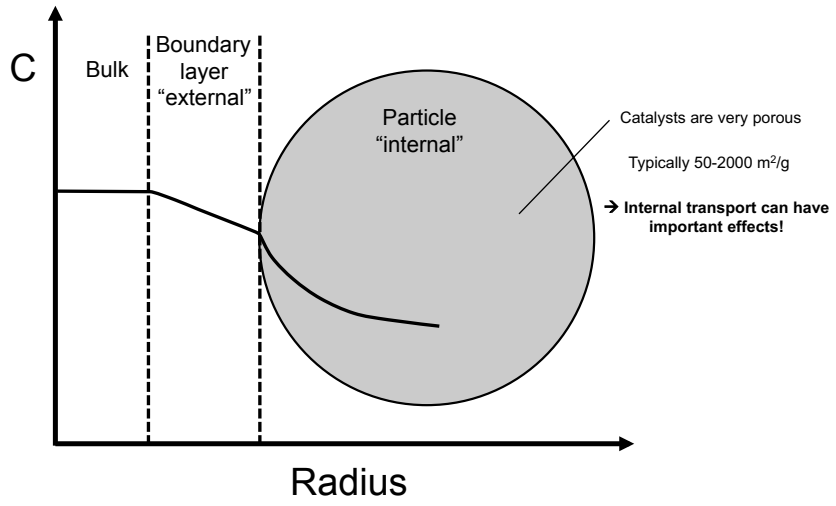
3 Transport effects in heterogeneous catalysis

Overview of the system:

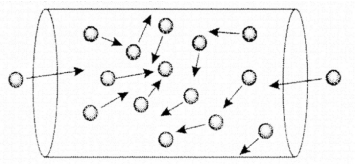


3

3 Transport effects in heterogeneous catalysis

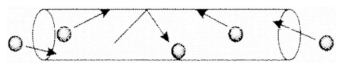
3.3.1 Types of pores and pore networks

- Molecular diffusion



In large pores (>1000 nm for molecules ~100 g/mol), molecules will hit themselves much more than the wall (=bulk diffusion)

- Knudsen diffusion



In smaller pores ($5<R_p<1000$ nm for molecules ~100 g/mol), molecules will increasingly hit the wall more than themselves

Knudsen diffusion coefficient [cm^2s^{-1}]

Pore radius [cm]

$$D_{KA} = 9.7\ 10^3 R_{po} \left(\frac{T}{M_A}\right)^{1/2}$$

T° [K]

Molecular weight [g/mol]

For a gas, D_{AB}~0.1 cm^2s^{-1}. For D_{KA} to be comparable, for a molecule where M_A~100 g/mol and T°=300 K, we need:

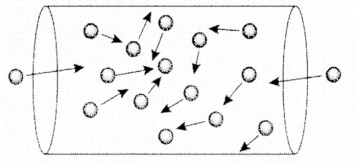
$0.1=10^4\ R_{po}\ (3)^{1/2}$ → R_{po} ~ 10^{-5} cm = 100 nm

4

3 Transport effects in heterogeneous catalysis

3.3.1 Types of pores and pore networks

- Molecular diffusion



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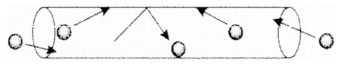
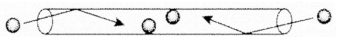


In smaller pores ($5<R_p<1000$ nm for molecules ~100 g/mol), molecules will increasingly hit the wall more than themselves

- Single file diffusion



Only one molecule can pass through the pore at a time (2-5 nm, depending on the molecule)

- Shape-selective/very small pore

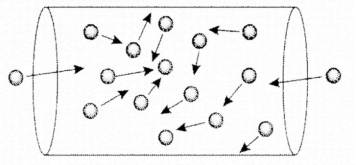
The pore is smaller than a molecule (< 2nm)

5

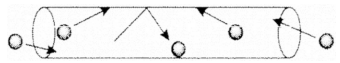
3 Transport effects in heterogeneous catalysis

3.3.1 Types of pores and pore networks

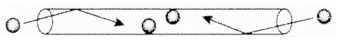
- Molecular diffusion



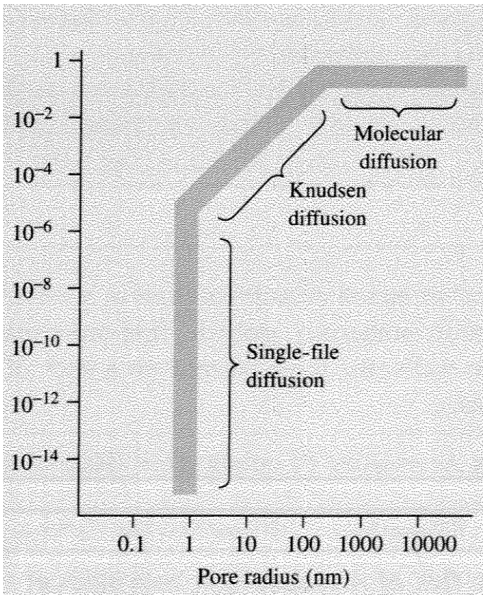
- Knudsen diffusion



- Single file diffusion



- Shape-selective/very small pore



6