Trimodally porous SnO_2 nanospheres for highly sensitive gas sensing of ethanol

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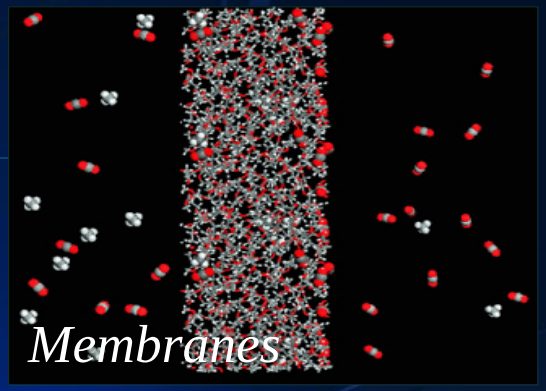
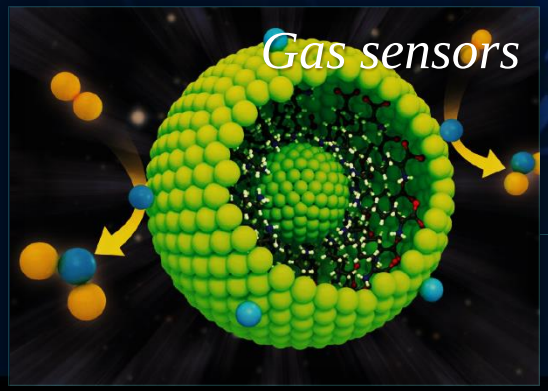
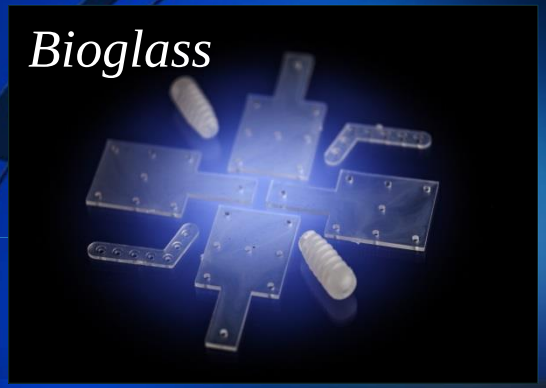
Introduction (Applications)

Porous Nanostructures

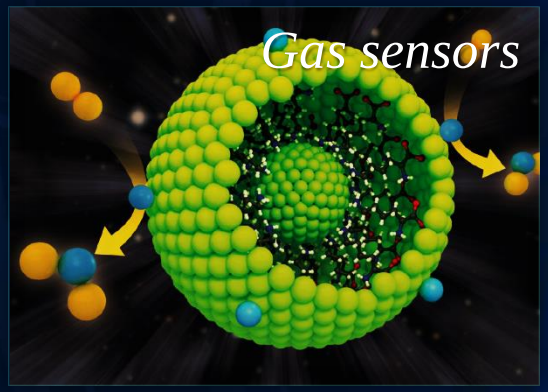




- *High surface area*
- *Rapid mass transfer*

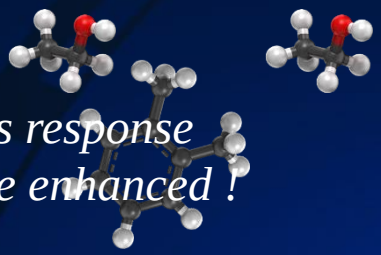


Introduction (Gas sensors)



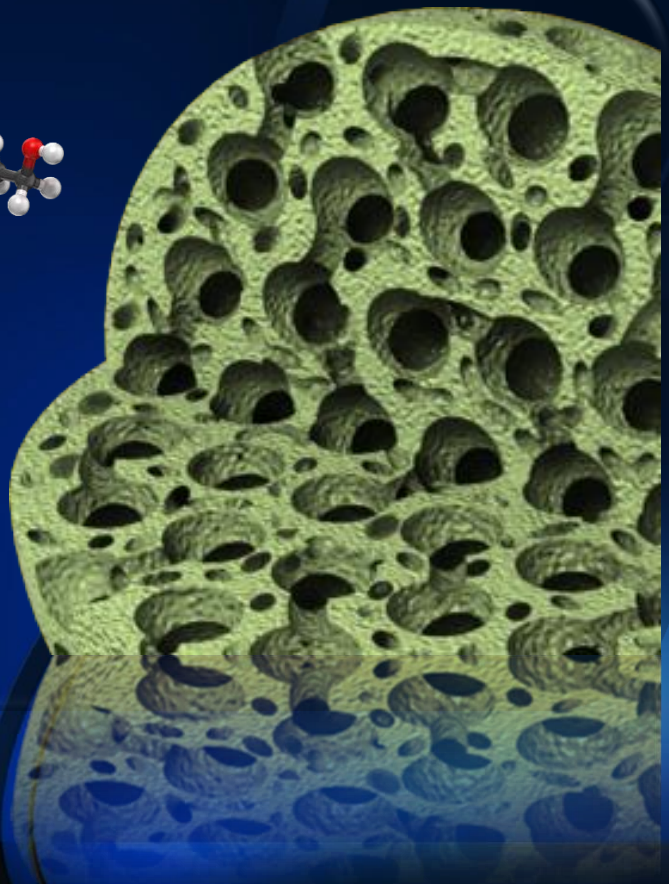
Excellent platform for highly sensitive and selective gas sensors ($S = R_a/R_g$ or R_g/R_a)

Porous structures



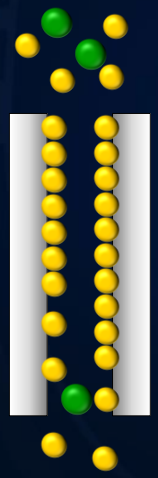
Gas response can be enhanced !

Reaction between analyte gas and sensing material can be enhanced !

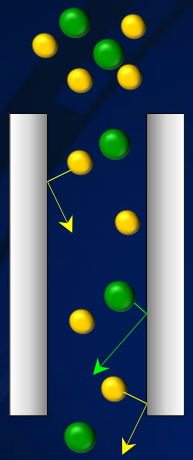


Introduction (Pore size effects)

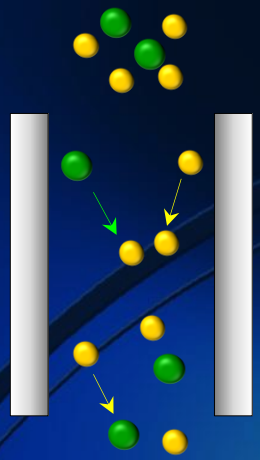
Micropores
< 2 nm
Surface diffusion
(< several nm)



Mesopores
2 ~ 50 nm
Knudsen diffusion
(< several tens of nm)



Macropores
> 50 nm
Molecular diffusion
(> 100 nm)



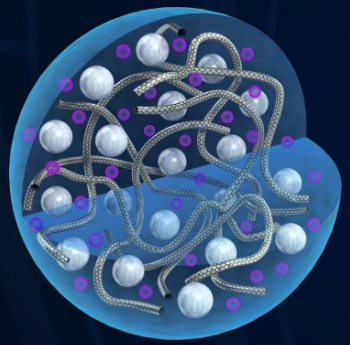
High surface area
Low gas accessibility

Low surface area
High gas accessibility

Porous materials with multimodal pores are advantageous for gas sensing !

Introduction (This work)

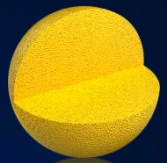
One-pot synthesis via spray pyrolysis



CO_2 generation → *Nanopore (~3 nm)*
CNT template → *Mesopores (~20 nm)*
PS template → *Macropores (~100 nm)*

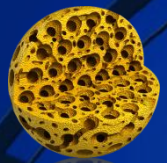
Porous SnO_2 spheres with 3-D interconnected trimodal pores

Materials



Dense → *No pore*

Bimodal → *Porosity ↑ Connectivity ↓*



Trimodal → *Porosity ↑ Connectivity ↑*

Suggestion of a new and novel porous structure for ultrasensitive gas sensing !

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