

ADVANCED FUNCTIONAL MATERIALS

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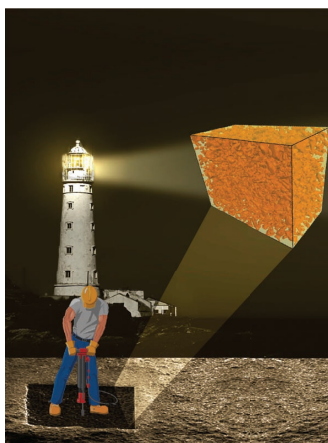


Structure Determination

Structural determination of many ordered porous solids is challenging because of the small crystal sizes. Electron crystallography can overcome the challenges. On page 182, X. D. Zou and co-workers review different electron microscopic techniques for structural determination of zeolites, metal–organic frameworks, and ordered mesoporous materials. Several recently developed methods, including the structure projection reconstruction from a through-focus series of high-resolution electron microscopy images, automated diffraction tomography and rotation electron diffraction, have made structural determination by electron crystallography today more efficient and more feasible.

Zeolites

On page 209, J. Pérez-Ramírez and co-workers quantify the superior mass-transfer properties of zeolite bodies with hierarchical porosity, which enables the design of more efficient industrial catalysts. The millimeter-sized extrudate illustrated in the cover image, containing ZSM-5 crystals and a clay-derived binder, integrates micro-, meso-, and macropores. This interconnected pore network enhances molecular transport, resembling the road system of the metropolis printed on the body. Carolina Flores is acknowledged for perfecting the cover artwork.



Metal–Organic Frameworks

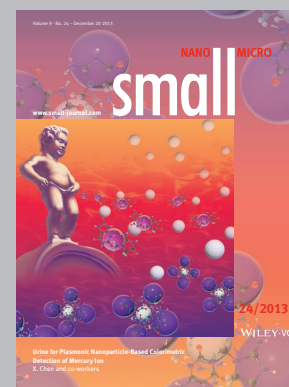
Focused ion beam-scanning electron microscopy (FIB-SEM) sheds light on the performance of MOF-based mixed matrix membranes. On page 249, 3D tomography is presented by T. Rodenas, J. Gascon, and co-workers as a powerful approach to assess the distribution of the MOF filler and its contact with the polymeric matrix. In addition, the influence of the MOF loading, its framework configuration in the membrane, and the influence of operation conditions on the CO_2/CH_4 separation performance are studied.



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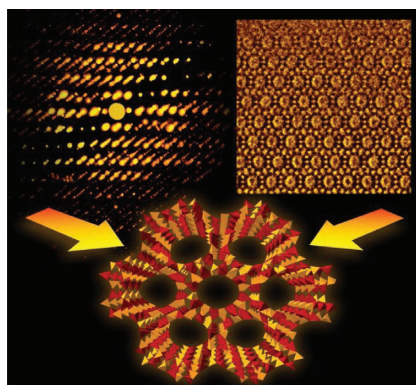
EDITORIAL

J. Pérez-Ramírez*180–181

Porosity: The Hegemony of Empty Space in Functional Materials Design

FEATURE ARTICLE

Structure Determination

T. Willhammar, Y. F. Yun,
X. D. Zou*182–199Structural Determination of
Ordered Porous Solids by Electron
Crystallography

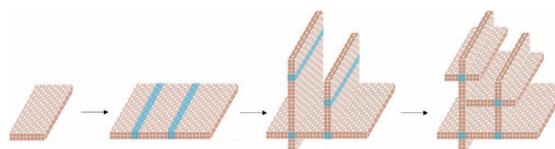
Recent developments in 3D electron diffraction and high resolution electron microscopy (HRTEM) for structure determination are reviewed. Both 3D electron diffraction and HRTEM can be used to solve unknown structures of porous materials. Various electron crystallographic methods are selected and used for solving different structural problems in zeolites, metal–organic frameworks, and ordered mesoporous materials.

FULL PAPERS

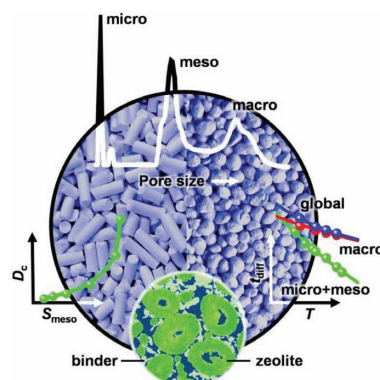
Zeolites

D. Xu, G. R. Swindlehurst, H. Wu,
D. H. Olson, X. Zhang,*
M. Tsapatsis*201–208On the Synthesis and Adsorption
Properties of Single-Unit-Cell
Hierarchical Zeolites Made by
Rotational Intergrowths

Self-pillared pentasil (SPP), a hierarchical zeolite, is formed by rotational intergrowth of MFI structures and MEL structures: the higher-symmetry structure (MEL, blue) serves as a connector to connect the lower-symmetry structure (MFI, red). This process is repeated over space and time, to achieve the formation of this all-crystalline hierarchical zeolite.



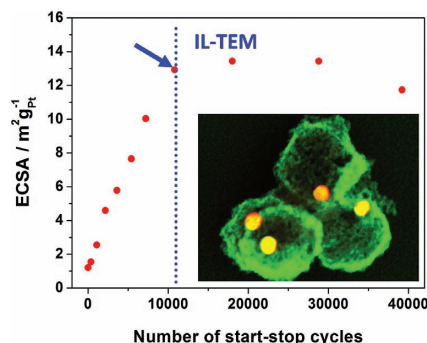
Zeolites

L. Gueudré, M. Milina, S. Mitchell,
J. Pérez-Ramírez* 209–219Superior Mass Transfer Properties
of Technical Zeolite Bodies with
Hierarchical Porosity

The first systematic study of the impact of shaping on the beneficial effects of intracrystalline mesopores on mass transfer in hierarchical ZSM-5 is presented. Using gravimetric adsorption studies of a bulky alkane probe, the enhancing effect of the developed mesopores can be preserved in multicomponent millimeter-sized granules and extrudates.

FULL PAPERS

Encapsulation of noble metals in graphitic hollow shells by hard templating is explored as a means for stabilizing fuel cell catalysts. Small platinum particles can be encapsulated, but the achievable loading is too small. Encapsulation of Au–Pt yolk–shell particles allows higher loading, and with such cores, stable catalysts could be produced.

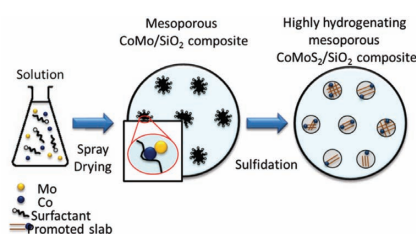


Fuel Cells

C. Galeano, C. Baldizzone, H. Bongard, B. Spliethoff, C. Weidenthaler, J. C. Meier, K. J. J. Mayrhofer, F. Schüth* 220–232

Carbon-Based Yolk–Shell Materials for Fuel Cell Applications

One-pot synthesis through spray drying of large structured porous (Co)Mo/SiO₂ composite presenting high hydrogenating activity is reported. This high activity is associated with both a tuned localization of the active species inside the mesopores and to the formation of nanoscopic molybdenum sulfide entangled slabs that likely promote the number of catalytically relevant defects.

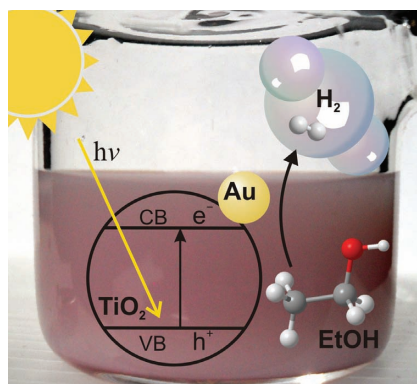


Catalysis

F. Colbeau-Justin, C. Boissière, A. Chaumonnot, A. Bonduelle, C. Sanchez* 233–239

Aerosol Route to Highly Efficient (Co)Mo/SiO₂ Mesoporous Catalysts

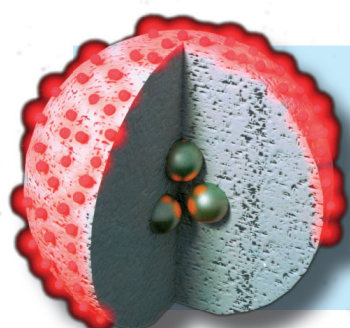
Simulated solar light irradiation of ethanolic Au/TiO₂ photocatalyst suspensions yields gaseous effluents of which ca. 99% is H₂, produced by reduction. Minor products are hydrocarbons, CO, and CO₂, whereas acetaldehyde, produced by oxidation, accumulates in the liquid phases. Production rates can be enhanced by using UV-richer light sources, up to 30 mmol g_{cat}^{−1} h^{−1}.



Hydrogen Production

A. V. Puga, A. Forneli, H. García, A. Corma* 241–248

Production of H₂ by Ethanol Photoreforming on Au/TiO₂



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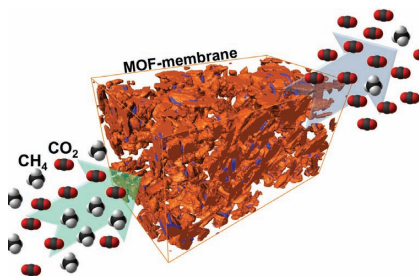
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FULL PAPERS

Metal-Organic Frameworks

- T. Rodenas,* M. van Dalen,
E. García-Pérez, P. Serra-Crespo,
B. Zornoza, F. Kapteijn,
J. Gascon*249–256

Visualizing MOF Mixed Matrix Membranes at the Nanoscale: Towards Structure-Performance Relationships in CO₂/CH₄ Separation Over NH₂-MIL-53(Al)@PI

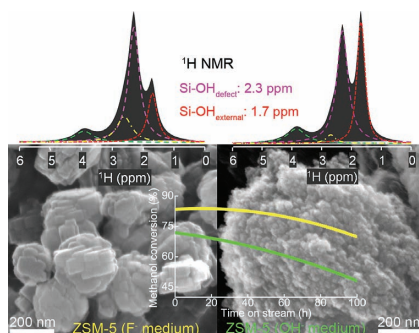


Mixed-matrix membranes composed of the flexible NH₂-MIL-53(Al) metal-organic framework (MOF) embedded in polyimide represent a promising alternative for CO₂ removal from natural gas and biogas. Quantitative focused ion beam scanning electron microscopy (FIB-SEM) tomography evidences an excellent filler-polymer contact. The loading of MOF crystals and its framework configuration, which can be adjusted during membrane casting, are key parameters for the gas separation performance.

Zeolites

- Z. Qin, L. Lakiss, L. Tosheva,
J.-P. Gilson, A. Vicente, C. Fernandez,
V. Valtchev*257–264

Comparative Study of Nano-ZSM-5 Catalysts Synthesized in OH[−] and F[−] Media



Nanosized ZSM-5 crystals are synthesized in a fluoride medium. Their intrinsic characteristics are compared with those of counterpart nanocrystals obtained in a hydroxyl medium. The catalytic performance of the two materials in methanol conversion is studied and the results are related to the effect of the synthesis conditions on the zeolite properties.