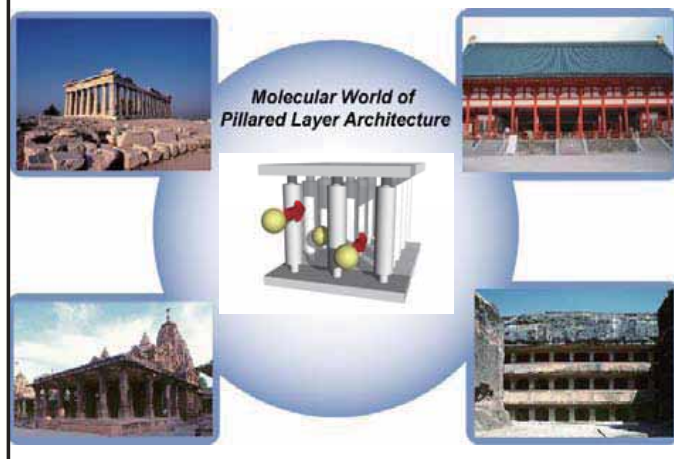
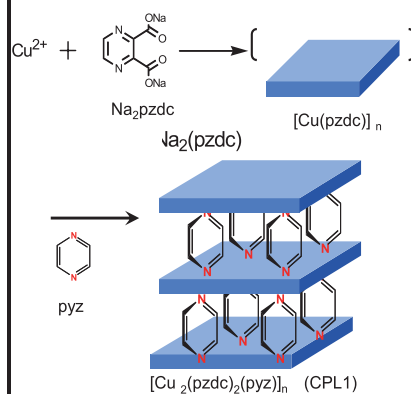


Pillared Layer Structures



Coordination Pillared Layer Structure (CPL Series)

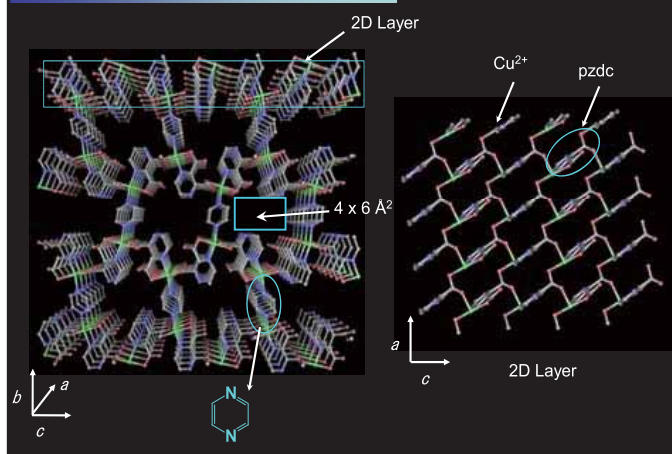


Chemistry & Industry, 191, 1999



Angew.Chem.Int.Ed. 1999, 38, 143

3-D Structure of $[\text{Cu}_2(\text{pzdc})_2(\text{pyz})]$ (CPL1)



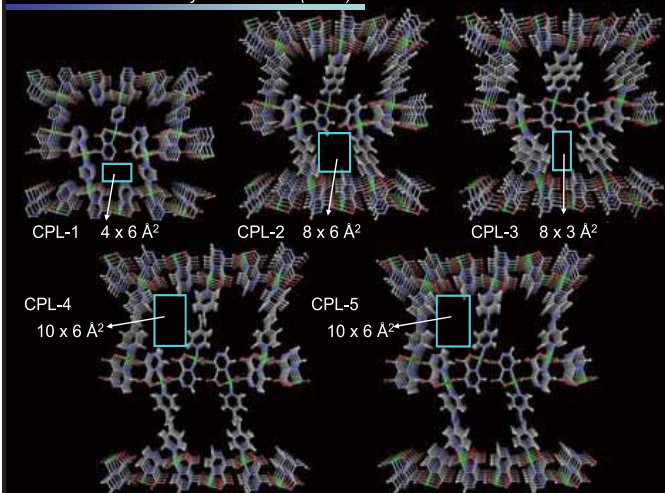
多孔性金属錯体 CPL系



CPL1

- 青色粉末結晶
- 250°Cまで安定な細孔骨格
- 大量合成できる
- 空気中で取り扱い可
- 多数回の吸脱着

Coordination Pillared Layer Structures (CPLs)

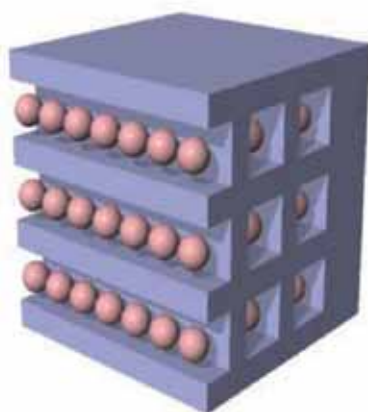


整列

生成



応答



分離

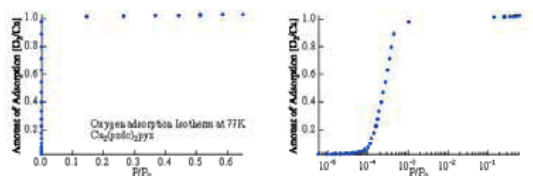
ポリマー合成



酸素分子を並べる

Adsorption Properties of CPL-1

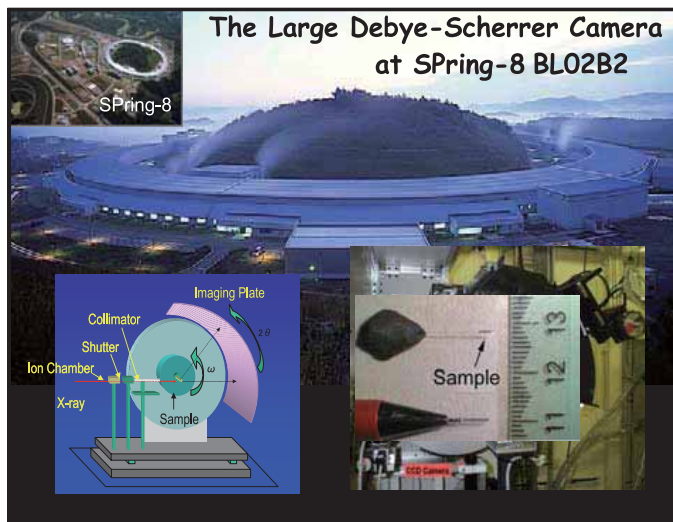
$$[\text{O}_2]/[\text{Cu}] = 1$$



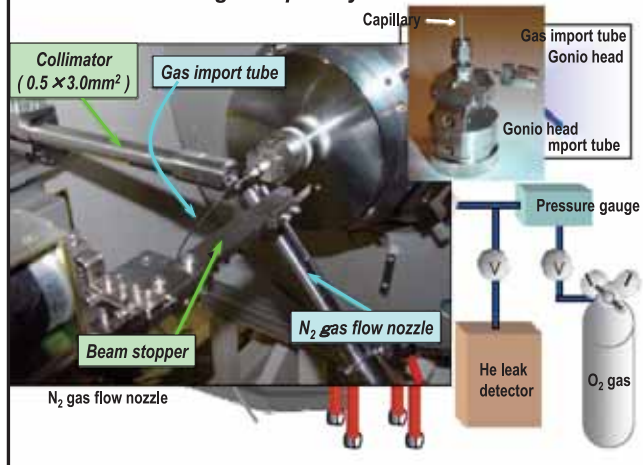
Isosteric heat of adsorption (CO_2)

CPL-1	-34 KJ/mol
Silicalite-I	-20 KJ/mol
AC	-25 KJ/mol

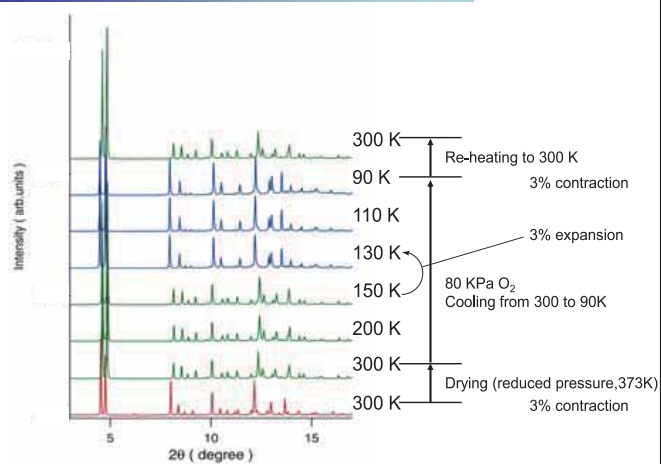
The Large Debye-Scherrer Camera at SPring-8 BL02B2

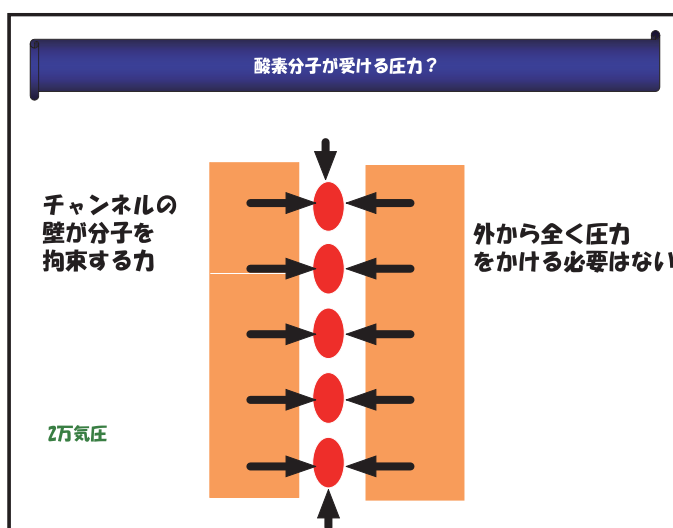
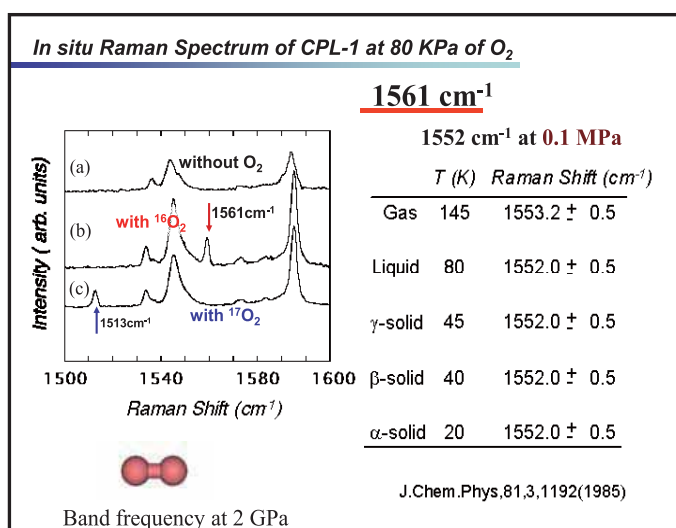
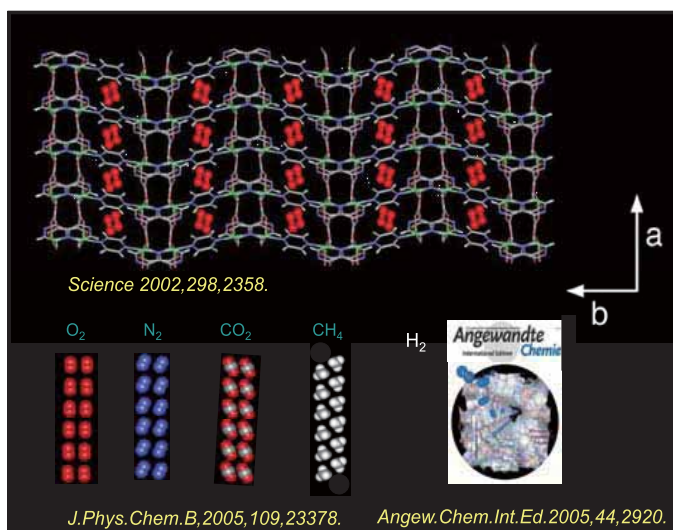
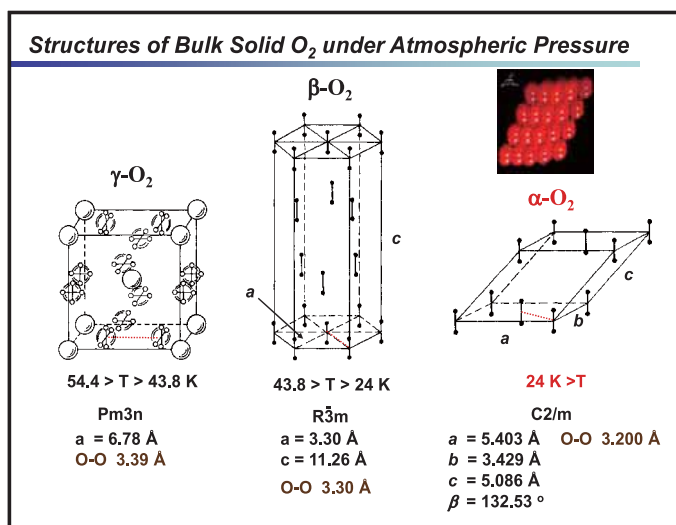


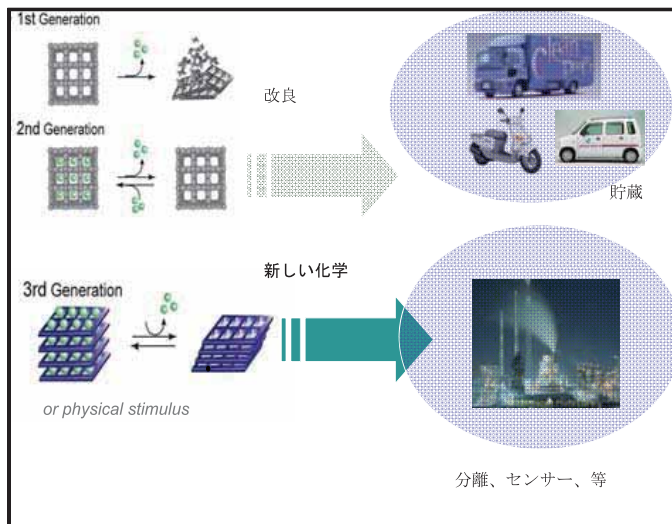
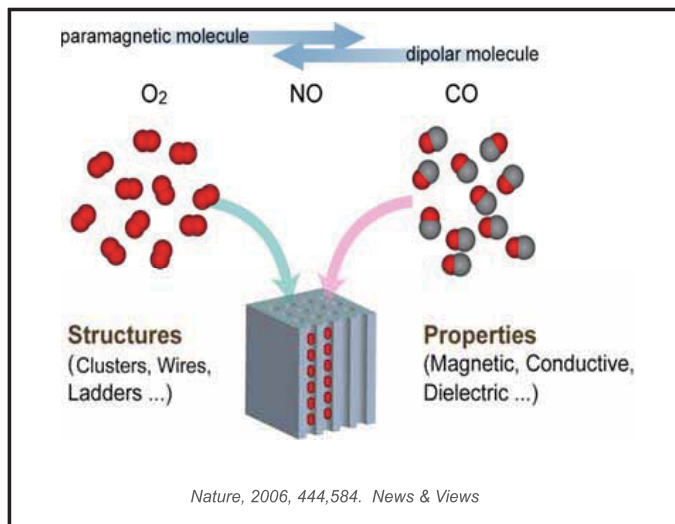
Schematic view of gas import system at BL02B2



XRPD Patterns of CPL-1 in 80 KPa O₂ Gas







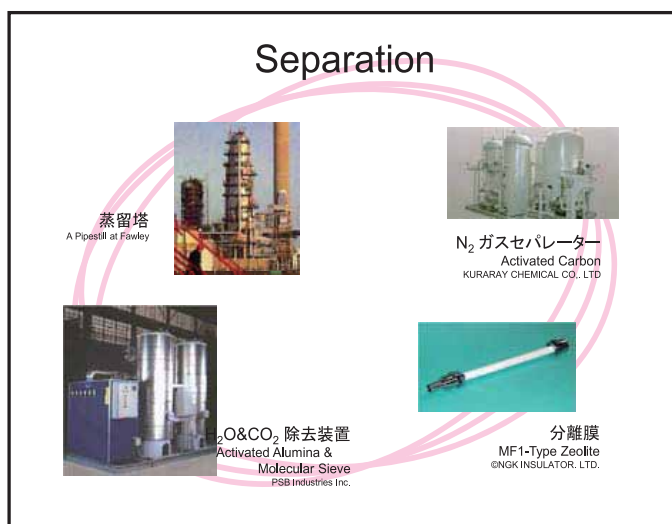
困難な操作

混合したものをそれぞれに分離する
空気 酸素/窒素 ...

覆水盆にかえらず！
コーヒーに砂糖を入れず塩を入れた、もとにもどせるか？

$\Delta S < 0$ エントロピーは増大する方向に

現在は可能である、しかし多大なエネルギーが必要

$$\Delta G = \Delta H - T\Delta S < 0$$


分離

厳密に分子を認識する空孔物質はない—新しい化学の展開が必要

- 日本の産業が消費するエネルギーの25%は化学産業、そのうち、50%は蒸留などの方法による分離に消費されている
- 分離は、古くから行われてきたが、画期的な進展はなかった
- 自在に分離できる技術は、革新的吸着材料から生まれる
- 従来、不可能とされてきた混合物の分離、環境汚染物質の除去、空気中からの希ガス(ppm)分離



石油コンビナートから蒸留塔が無くなる？
基本特許は欧米の技術



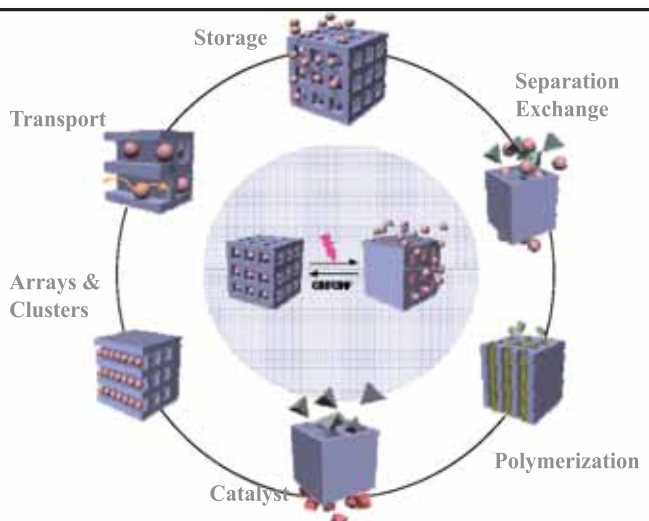
空気分離塔が1m以下のサイズ？

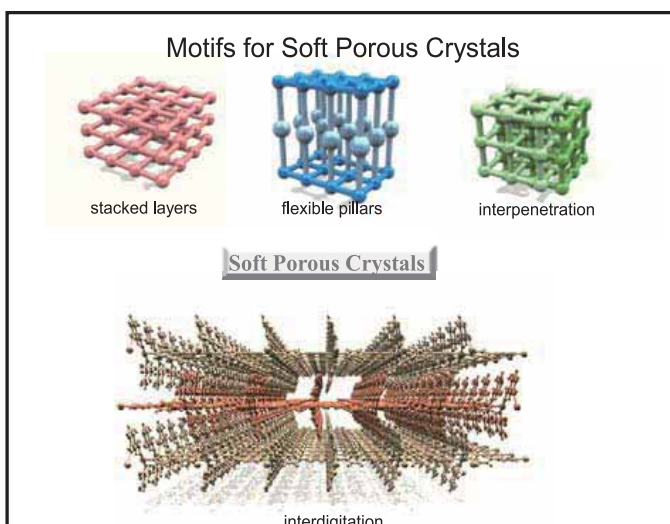
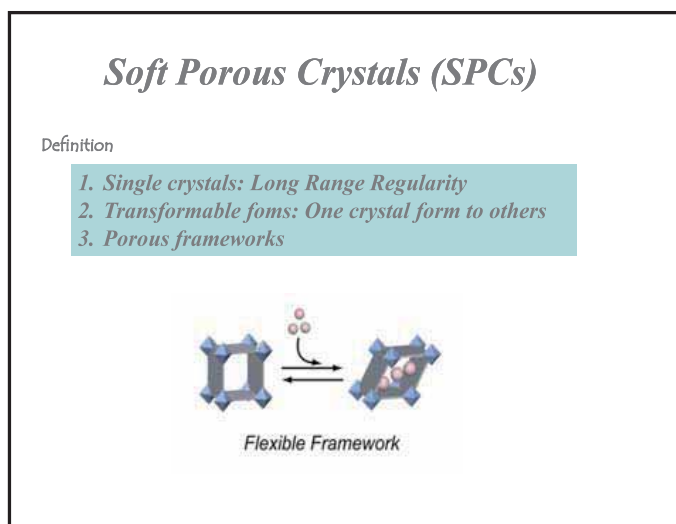
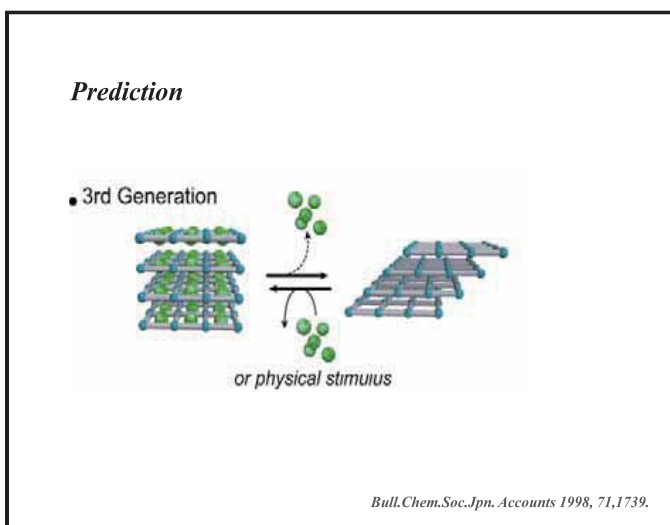
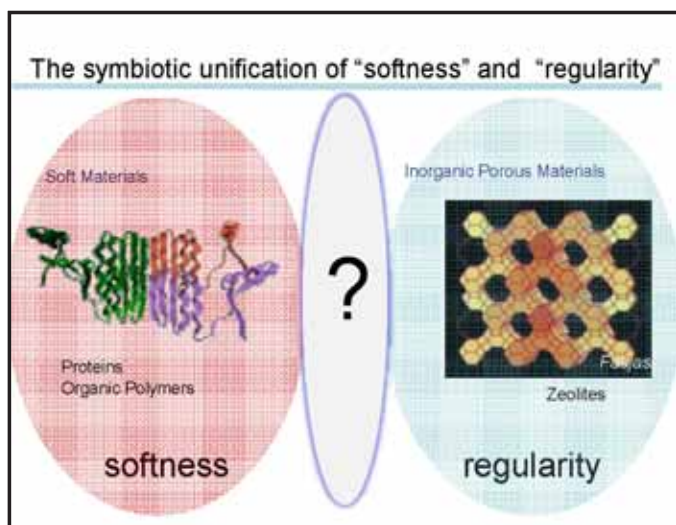
空気中の成分気体

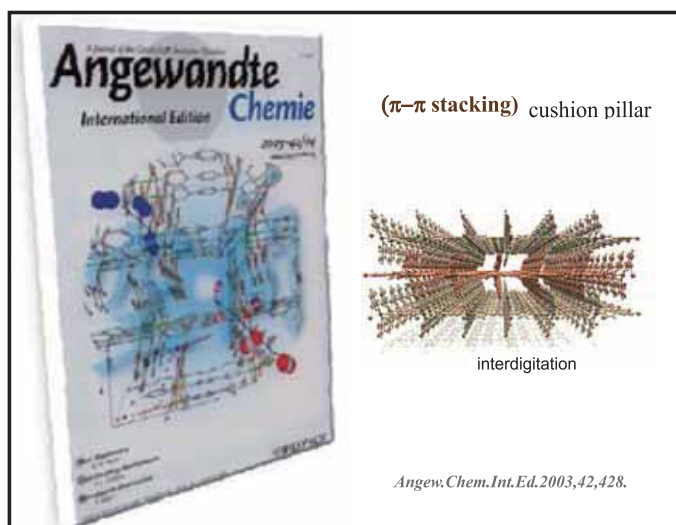
- 窒素(78 %, -196°C)
- 酸素(21 %, -183°C)
- アルゴン(0.94 %, -186°C)
- 二酸化炭素(330 ppm, -78.5°C)

6畳間×100室(3000 m³)
空気

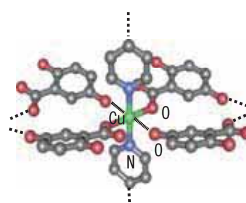
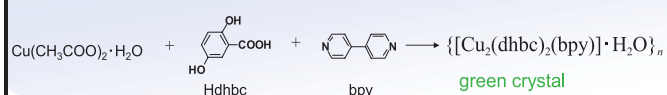
- ・ネオン (600 mL)
- ・アルゴン(31.6 L)
- ・ヘリウム (173 mL)
- ・クリプトン(37 mL)
- ・キセノン (3 mL)



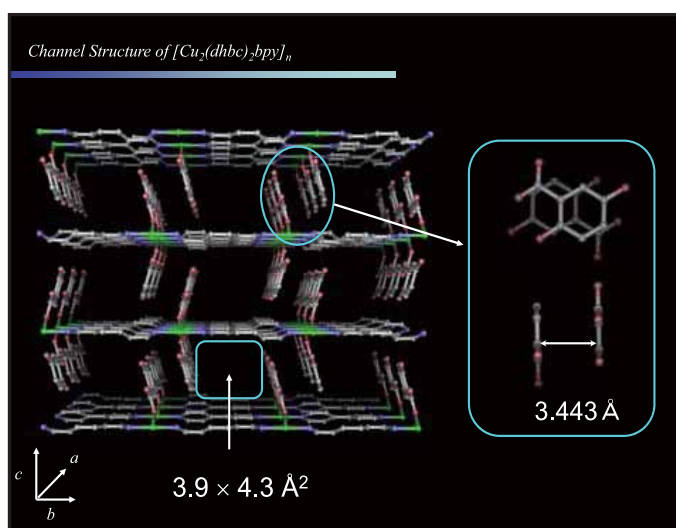
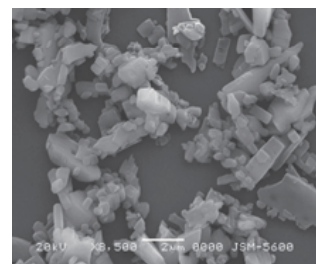




Synthesis of π -stacked pillared layer structure



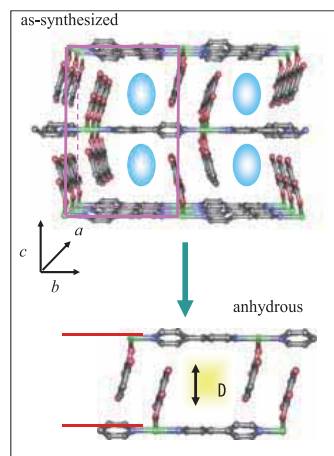
Monoclinic, P2/c (#13)
 $a = 8.167(4)$, $b = 11.094(8)$ Å,
 $c = 15.863(2)$ Å $\beta = 99.703(4)^\circ$,
 $V = 1416(1)$ Å³, $Z = 2$
 $R = 0.065$, $R_w = 0.103$

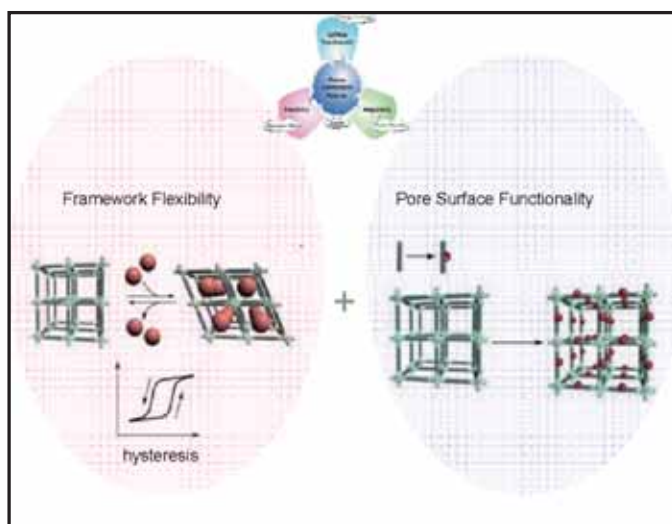
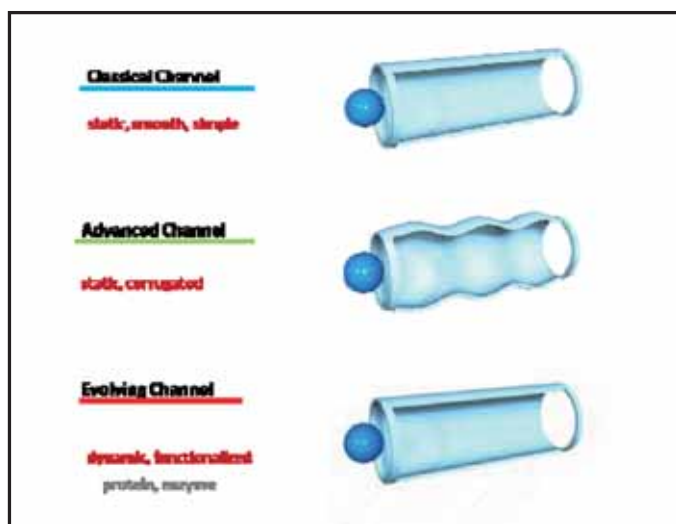
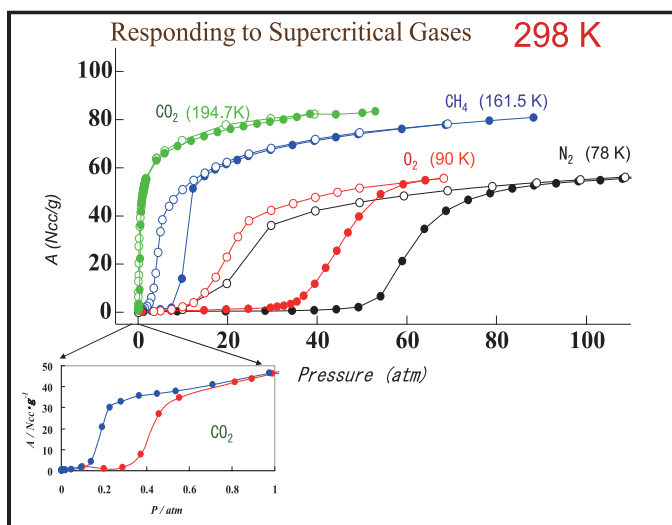
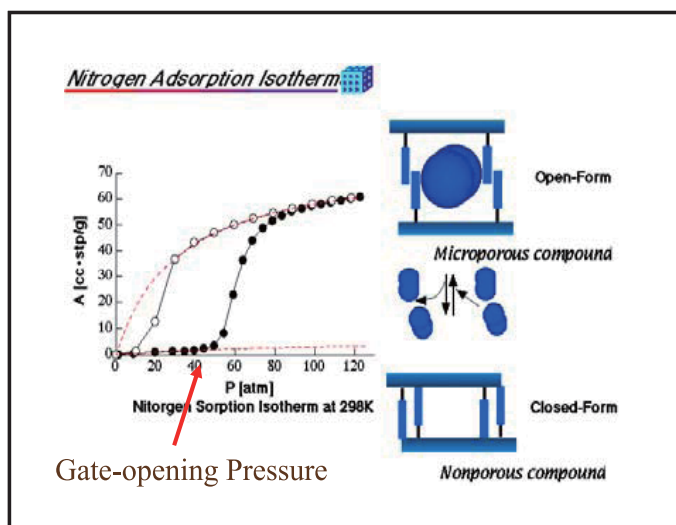


Cell Parameters

	CPL-p1	CPL-p1*
$a / \text{\AA}$	8.167(4)	8.119(4)
$b / \text{\AA}$	11.094(8)	11.991(6)
$c / \text{\AA}$	15.863(2)	11.17(1)
β / deg	99.703(4)	106.27(2)
$D / \text{\AA}$	4.3	2.0
$V / \text{\AA}^3$	1416(1)	1033(1)
$\rho / \text{g} \cdot \text{cm}^{-3}$	1.22	1.67

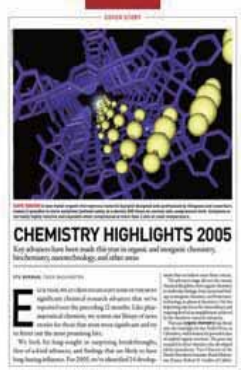
27 % の体積変化



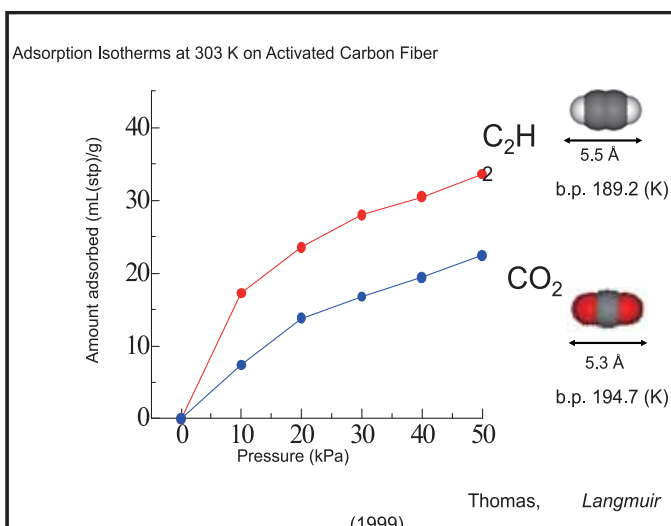
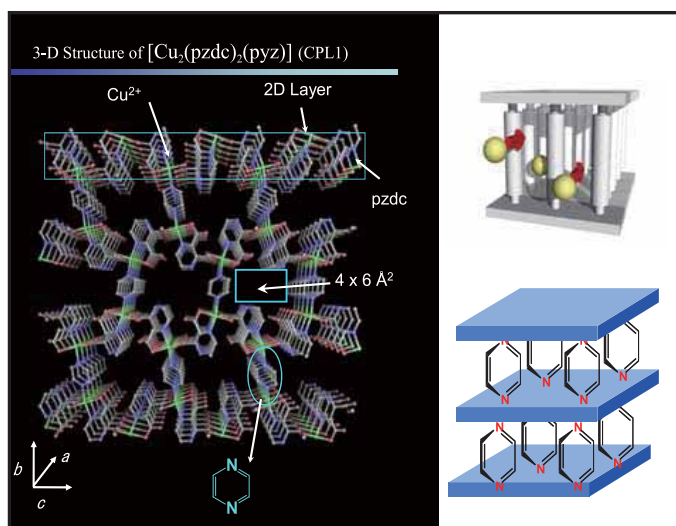
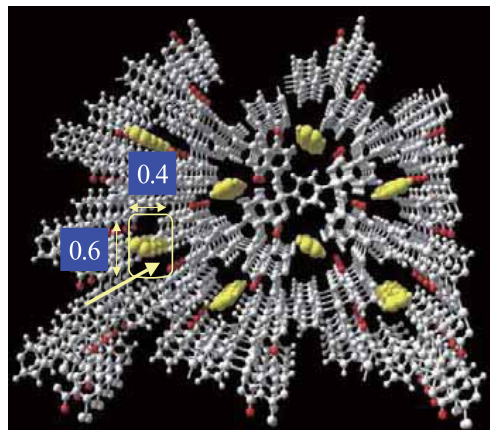


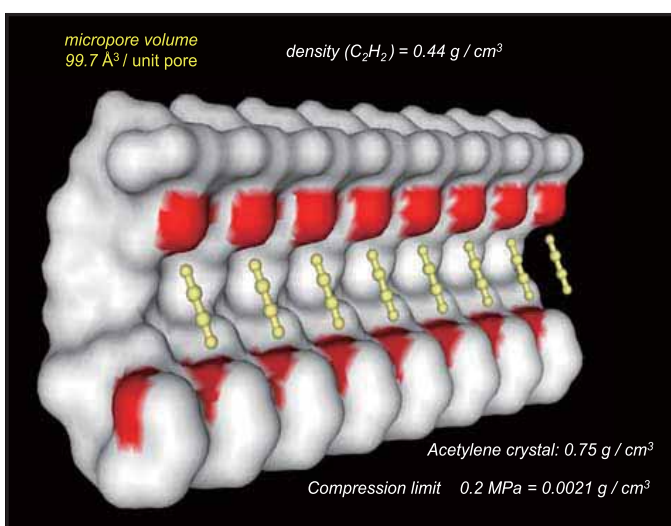
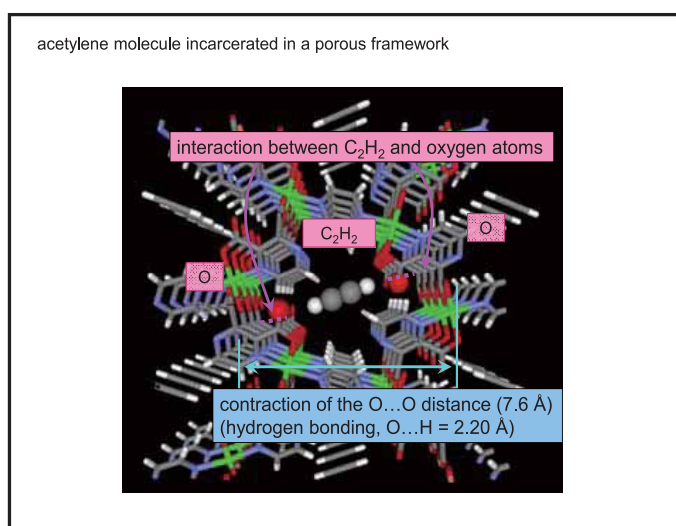
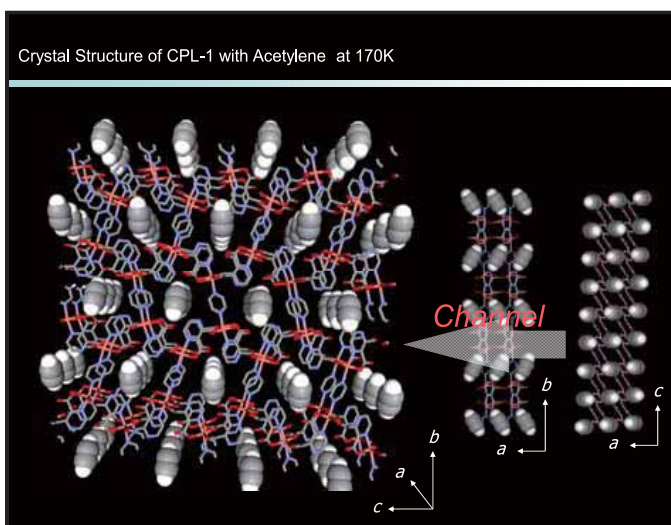
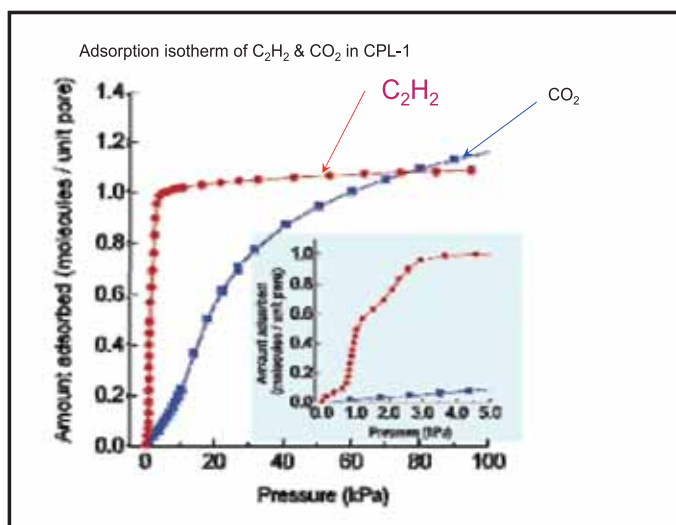


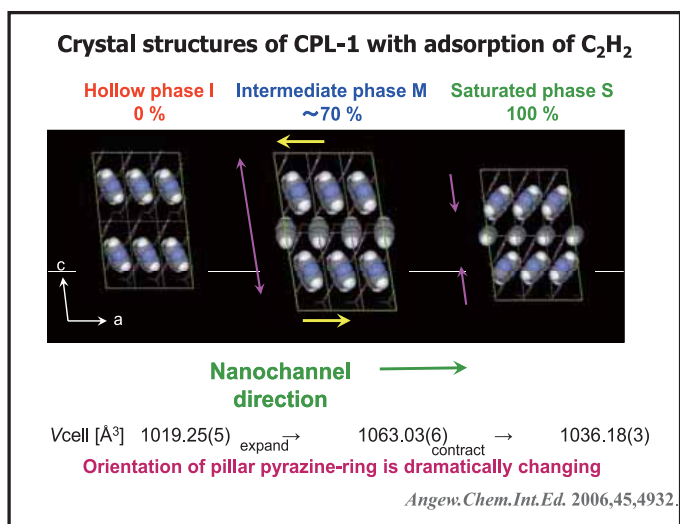
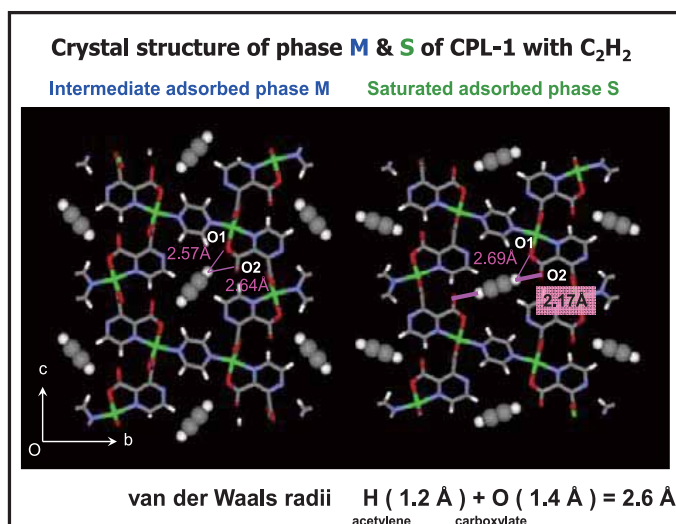
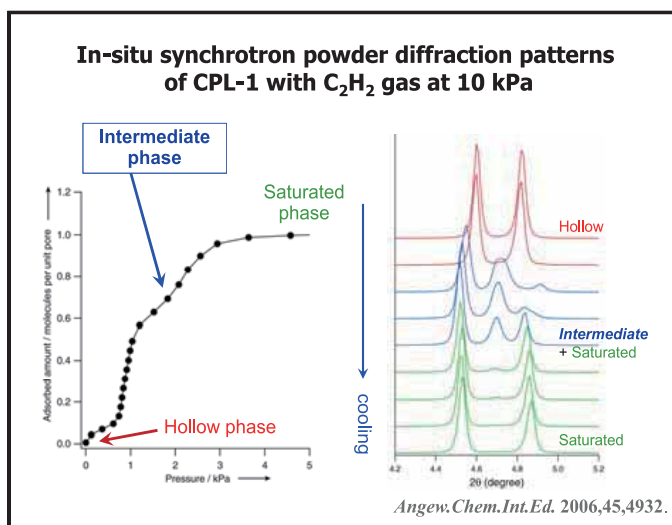
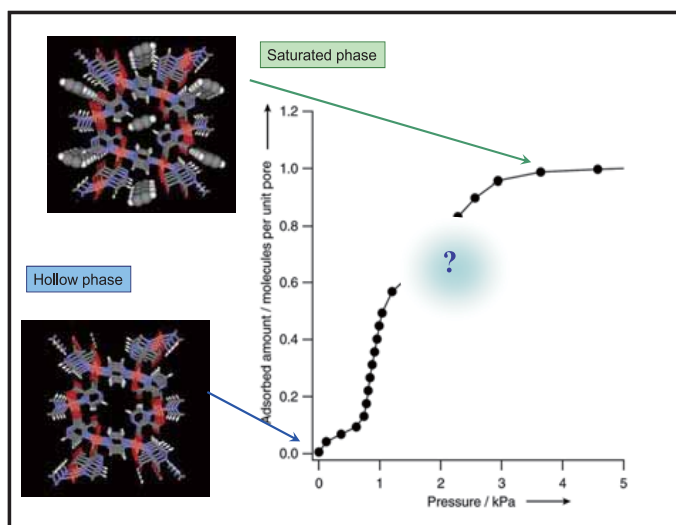
米国化学会 会員誌 2005年ハイライト
トップページ
C & E News
Highlights 2005

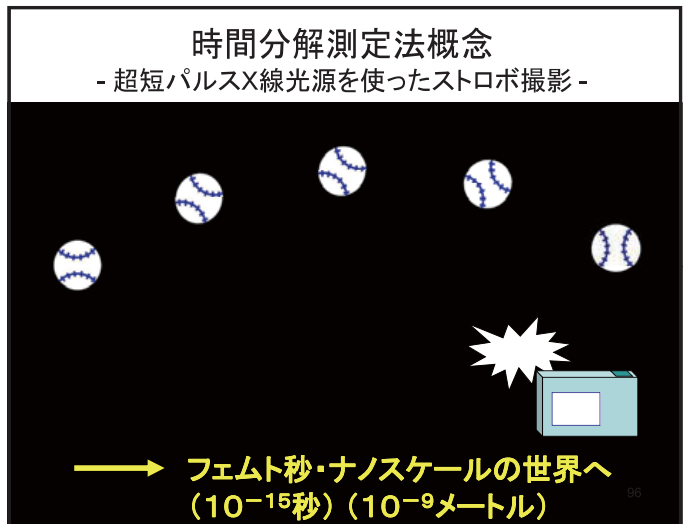
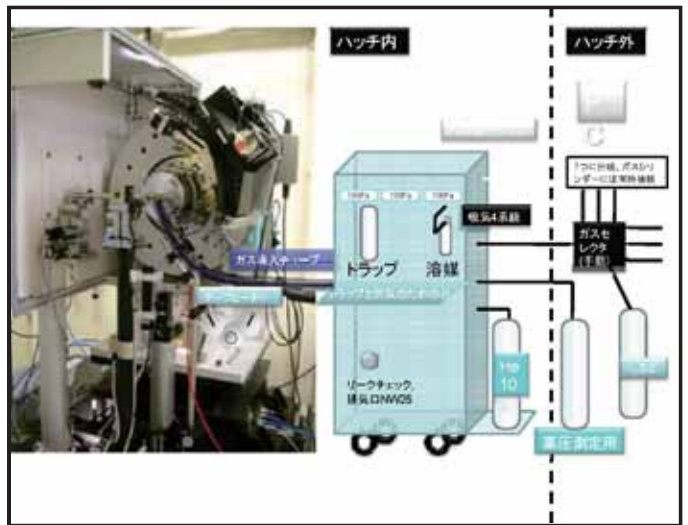
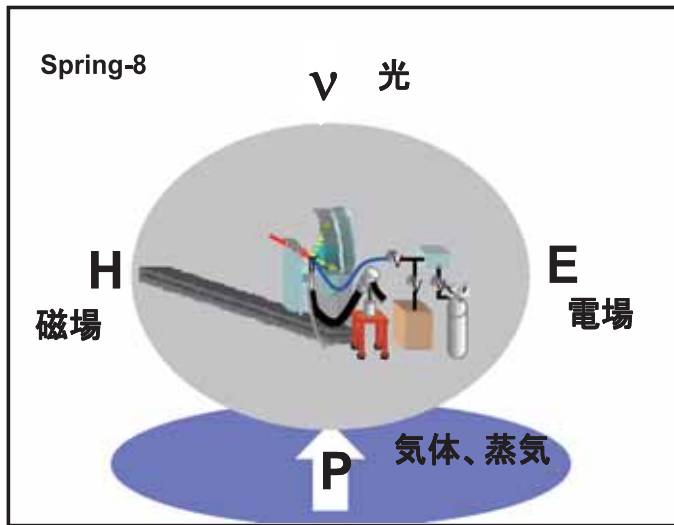


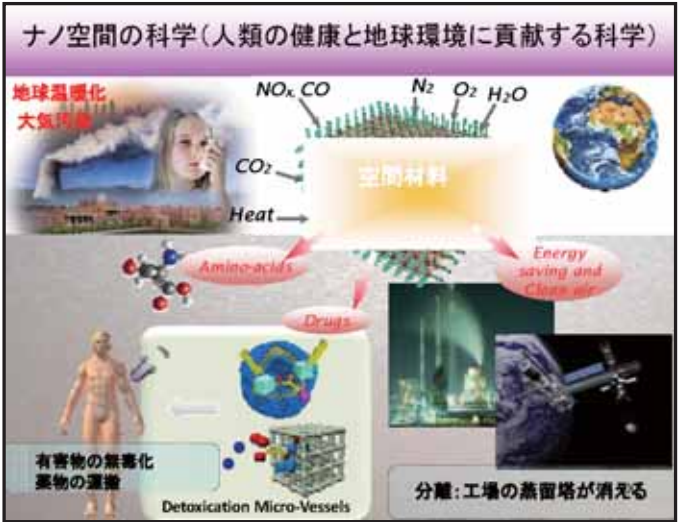
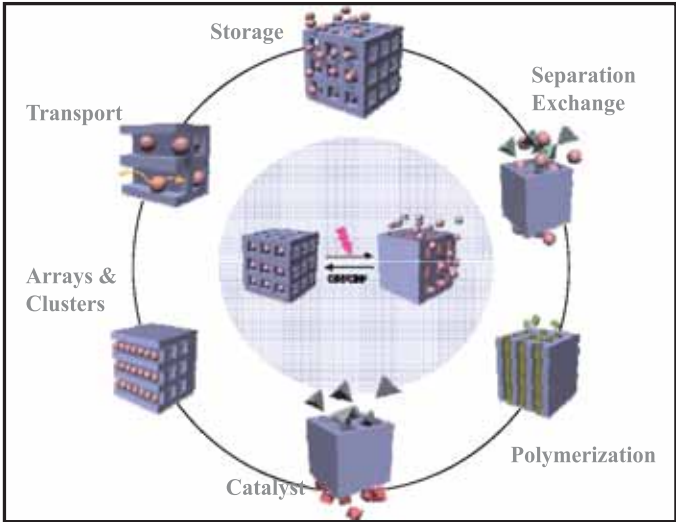
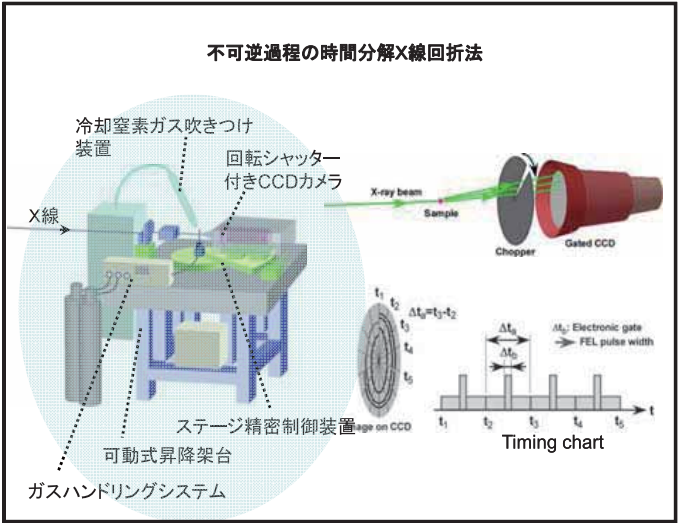
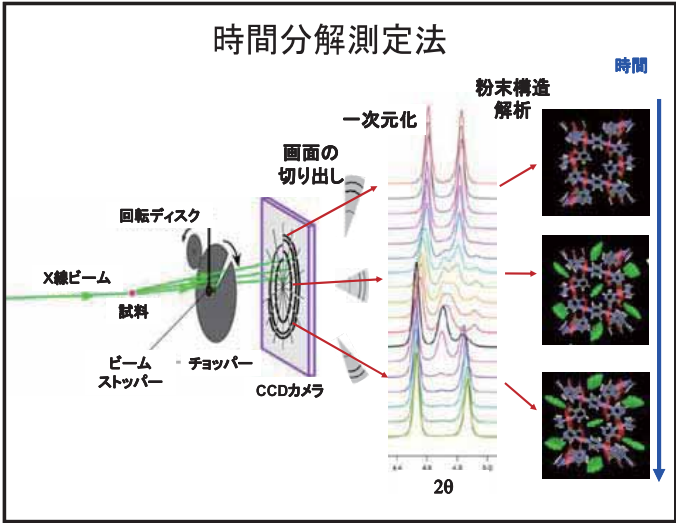
-Nature, 2005, 436, 238.
-Nature, 2005, 436, 187. News & Views













Kyoto University

Dr. Masa-aki Ohba Dr. Chang Ho-Chol

Dr. Takashi Uemura Dr. Kumar Tapas Maji



Dr. Ryo Kitaura Dr. Shin-ichiro Noro Dr. Kazuhiro Uemura

Dr. Ryotaro Matsuda Dr. Satoshi Horike George Akiyama

Kana Kitagawa

Prof. Minoru Miyahara Dr. Jyun-ya Hasegawa

Riken SPring-8

Prof. Masaki Takata Okayama Univ.

Osaka Prefecture Univ. Prof. Tatsuo Kobayashi

Dr. Yosiki Kubota Osaka Univ.

Tohoku Univ. Yosimi Mita

Prof. Yoshiyuki Kawazoe Nagoya Univ.

Dr. Rodion V. Belosludov Prof. Masataka Nagaoka

Riken Osaka Gas Co.

JSPS Dr. Kenji Seki

“Integrated Pores” ERATO, JST

“Chemistry of Coordination Space” MEXT