Interzeolite conversion of micronsized FAU to nanosized CHA zeolite free of organic structure directing agent with high a CO₂ capacity

Kristoffer H. Møller¹,², Maxime Debost³, Louwanda Lakiss², Søren Kegnæs¹*, Svetlana Mintova²*

¹Technical University of Denmark, Department of Chemistry, Kemitorvet 207, 2800 Kongens Lyngby, Denmark
²ENSICAEN, Laboratoire Catalyse & Spectrochimie, 6 Boulevard Maréchal Juin, 14050 Caen Cedex 4, France

Supporting information
Table S1: List of conditions for selected synthesis samples

| Entry # | Name          | FAU source | H$_2$O/Si | K/Si | Na/Si | Time / h | Phase      | Yield$^a$ |
|---------|---------------|------------|-----------|------|-------|----------|------------|-----------|
| 1       | CHA(1.9)      | CBV400     | 40        | 0.76 | 0.25  | 96       | CHA*       | 113%      |
| 2       |               | CBV400     | 40        | 0.51 | 0.51  | 96       | CHA + minor FAU |         |
| 3       |               | CBV720     | 30        | 0.5  | -     | 168      | Amorphous  |           |
| 4       | CHA(2.3)      | CBV720     | 30        | 1    | -     | 168      | CHA**      | 24%       |

$^a$Yield calculated by (mass product)/(mass starting zeolite) *Minor impurity of LTA or GME
**Minor impurity of LTL

ICP analysis

Table S2: ICP results for CHA zeolite samples

| Sample  | Si/Al | Na/Al | K/Al |
|---------|-------|-------|------|
| CHA(1.9)| 1.9   | 0.06  | 0.93 |
| CHA(2.3)| 2.3   | 0.01  | 0.97 |
Figure S1: SEM images of (A) FAU(15), (B) CHA(2.3), (C) FAU(2.6), and (D) CHA(1.9) zeolite samples
Figure S2: SEM image of CHA(2.3) zeolite

Figure S3: SEM image of CHA(1.9) zeolite
TEM images

Figure S4: TEM image of CHA(1.9)

Figure S5: TEM image of CHA(2.3)

Nitrogen physisorption of FAU(2.6), FAU(15), CHA(1.9), and CHA(2.3) zeolite samples
**Figure S6**: Nitrogen physisorption isotherm of FAU(2.6) zeolite at 77K

**Figure S7**: Nitrogen physisorption isotherm of FAU(15) zeolite at 77K
Figure 8: Nitrogen physisorption of CHA(1.9) at 77 K

Figure S9: Nitrogen physisorption of CHA(2.3) at 77 K
Table S3. Calculated porosity of FAU and CHA samples by N₂ physisorption at 77 K

| Sample   | \( V_{\text{total}} \)(cm\(^3\)/g)\(^a\) | \( V_{\text{micropore}} \)(cm\(^3\)/g)\(^b\) | \( S_{\text{BET}} \)(m\(^2\)/g)\(^c\) | \( S_{\text{ext}} \)(m\(^2\)/g)\(^b,c\) |
|----------|---------------------------------|---------------------------------|-----------------|-----------------|
| FAU(2.6) | 0.49                            | 0.280                           | 695             | 140             |
| FAU(15)  | 0.36                            | 0.280                           | 606             | 62              |
| CHA(1.9) | 0.07                            | 0.004                           | 43              | 33              |
| CHA(2.3) | 0.39                            | 0.045                           | 251             | 162             |

\(^a\) Single point adsorption \(^b\) Determined by the t-plot method \(^c\) Determined by the Brunauer-Emmett-Teller method

**CO₂ FTIR spectroscopic study**

![CO₂ FTIR spectroscopic study](image)

Figure S10. IR spectra of CO₂ adsorbed on CHA(2.3) in the region of 3820-3510 cm\(^{-1}\)
Figure S11. IR spectra of pulsed CO$_2$ adsorbed on CHA(1.9) in the region of 2000-1250 cm$^{-1}$
Figure S12. IR spectra of pulsed CO₂ adsorbed on CHA(1.9) in the region of 2500-2200 cm⁻¹
Figure S13. IR spectra of pulsed CO$_2$ adsorbed on CHA(1.9) in the region of 3800-3500 cm$^{-1}$
Figure S14: IR spectra of pulsed CO$_2$ adsorbed on CHA(2.3) and after desorption at $10^{-5}$ torr
CO FTIR spectroscopic study

Figure S15. IR spectra of CO adsorbed on CHA(1.9) at 77 K.