**SUPPLEMENTARY MATERIAL**

**for**

**Synthesis of CuO Nanostructures on Zeolite-Y and Investigation of Their CO2 Adsorption Properties**

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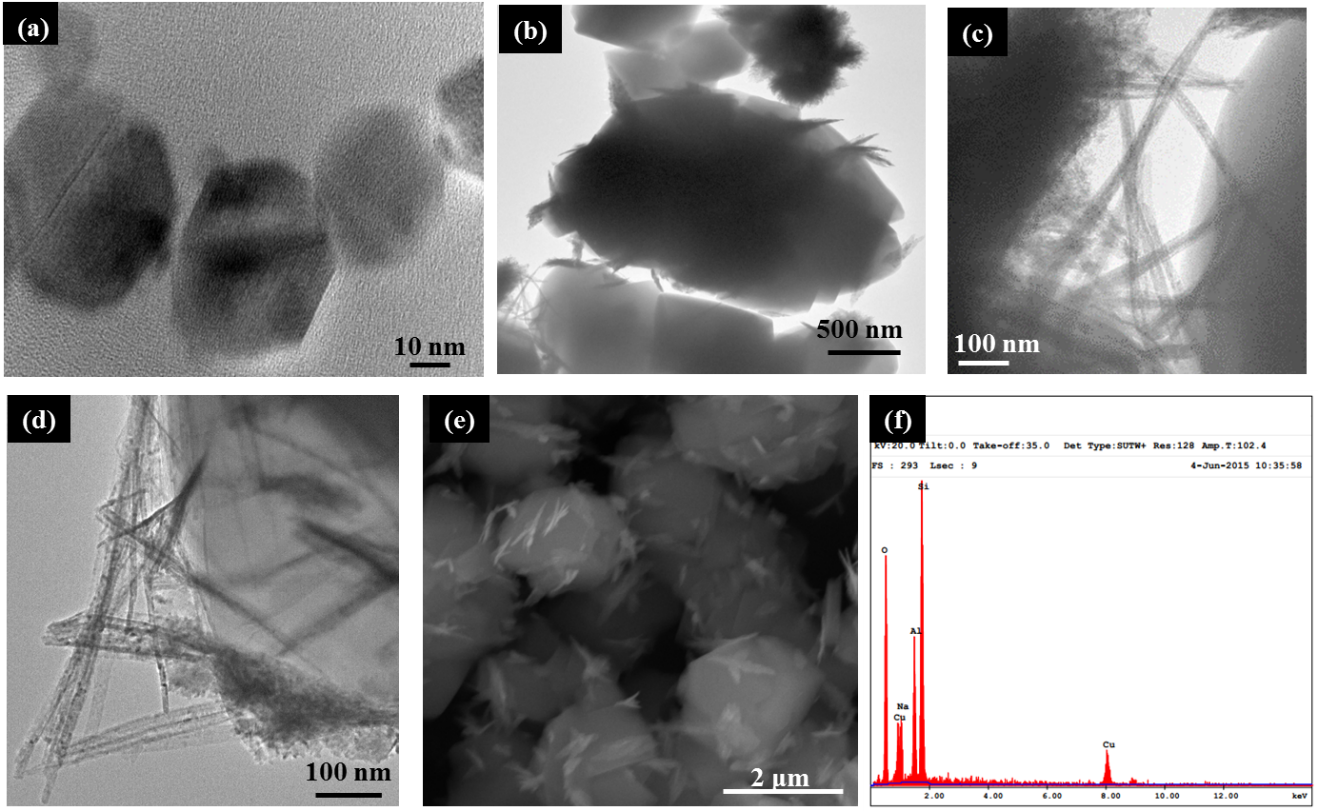
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FIG S1. (a) TEM images of bare zeolite; (b-d) TEM images, (e) SEM image and (f) EDX spectrum of spiky-shaped CuO NPs on zeolite.

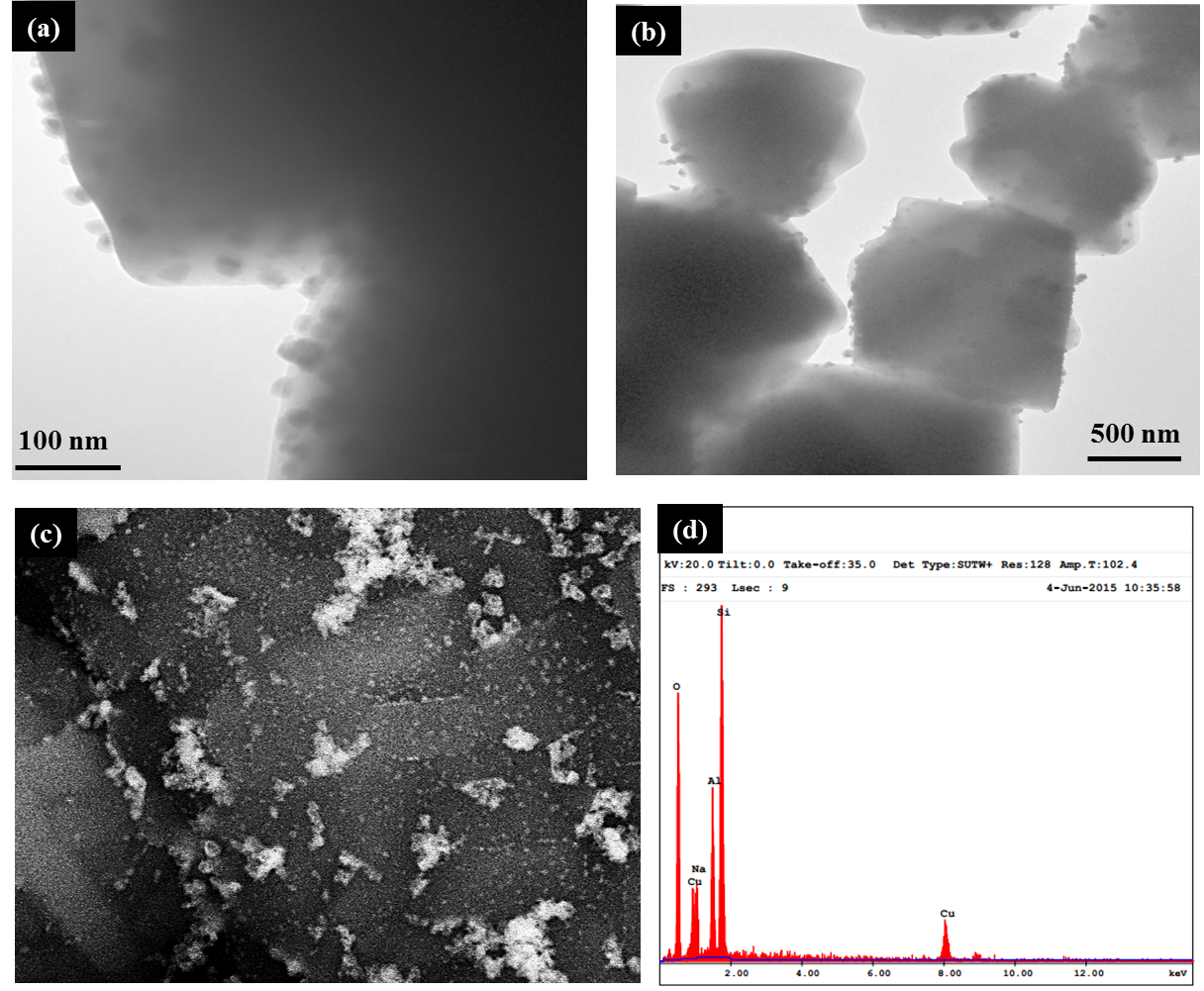
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FIG S2. (a-b) TEM images, (c) back-scattered SEM, and (d) EDX spectrum of spherical CuO NPs on zeolite.

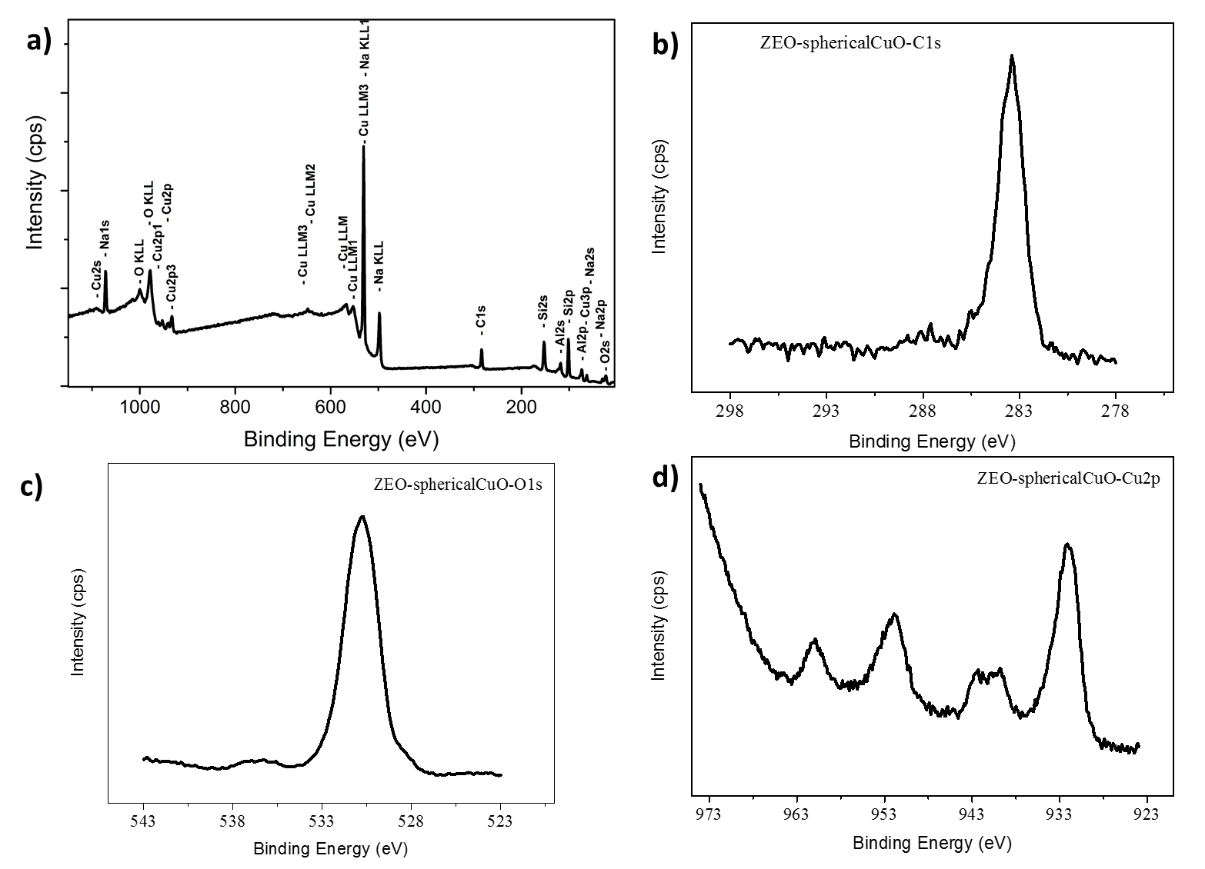
 FIG S3. XPS spectra of spherical CuO NPs on zeolite: a) survey, b) C1s, c) O1s, and   
d) Cu2p.



FIG. S4. N2 adsorption isotherms of zeolite-Y (square), zeolite containing spherical (sphere) and spiky CuO NPs (triangle).



FIG. S5. TPD-CO2 profile of CO2 desorption behavior of (a) bare zeolite, (b) spherical and (c) spiky CuO NP-zeolite systems.

TABLE SI. The amount of CO2 adsorbed by physically and chemically on zeolite, zeolite with spiky and spherical CuO NPs. The sample amounts used in measurements are given in parenthesis.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Total CO2 | | | Physisorbed CO2 | | | | Chemisorbed CO2 | | |
|  | mg | mmol/g | % wt\* | | mg | mmol/g | % wt\* | | mg | mmol/g |
| Zeolite (4.926 mg) | 0.916 | 4.226 | 62 | | 0.568 | 2.620 | 38 | | 0.348 | 1.606 |
| Zeolite- spherical CuO (5.061 mg) | 1.146 | 5.146 | 42 | | 0.481 | 2.161 | 58 | | 0.665 | 2.985 |
| Zeolite- spiky CuO (5.127 mg) | 1.192 | 5.284 | 36 | | 0.429 | 1.884 | 64 | | 0.763 | 3.400 |

\*Relative percent weight values obtained from TPD measurements.

|  |  |
| --- | --- |
|  | % weight loss |
| Fresh | 23.24 |
| 1st regeneration | 22.95 |
| 2st regeneration | 23.06 |
| 3rd regeneration | 23.11 |
| 4th regeneration | 22.66 |

TABLE SII. Regeneration of spiky CuO NP-zeolite system. % weight loss of the system after every adsorption-desorption cycle.

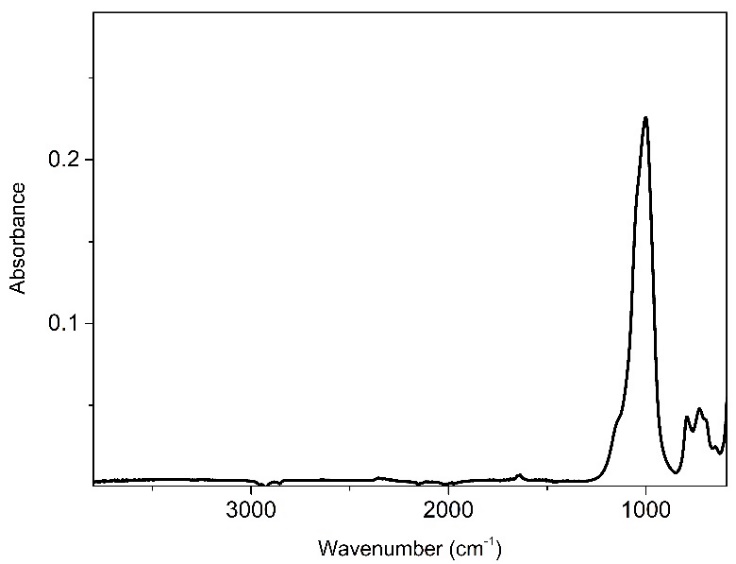


FIG S6. FTIR-ATR spectrum of virgin (without CO2 treatment) zeolite.

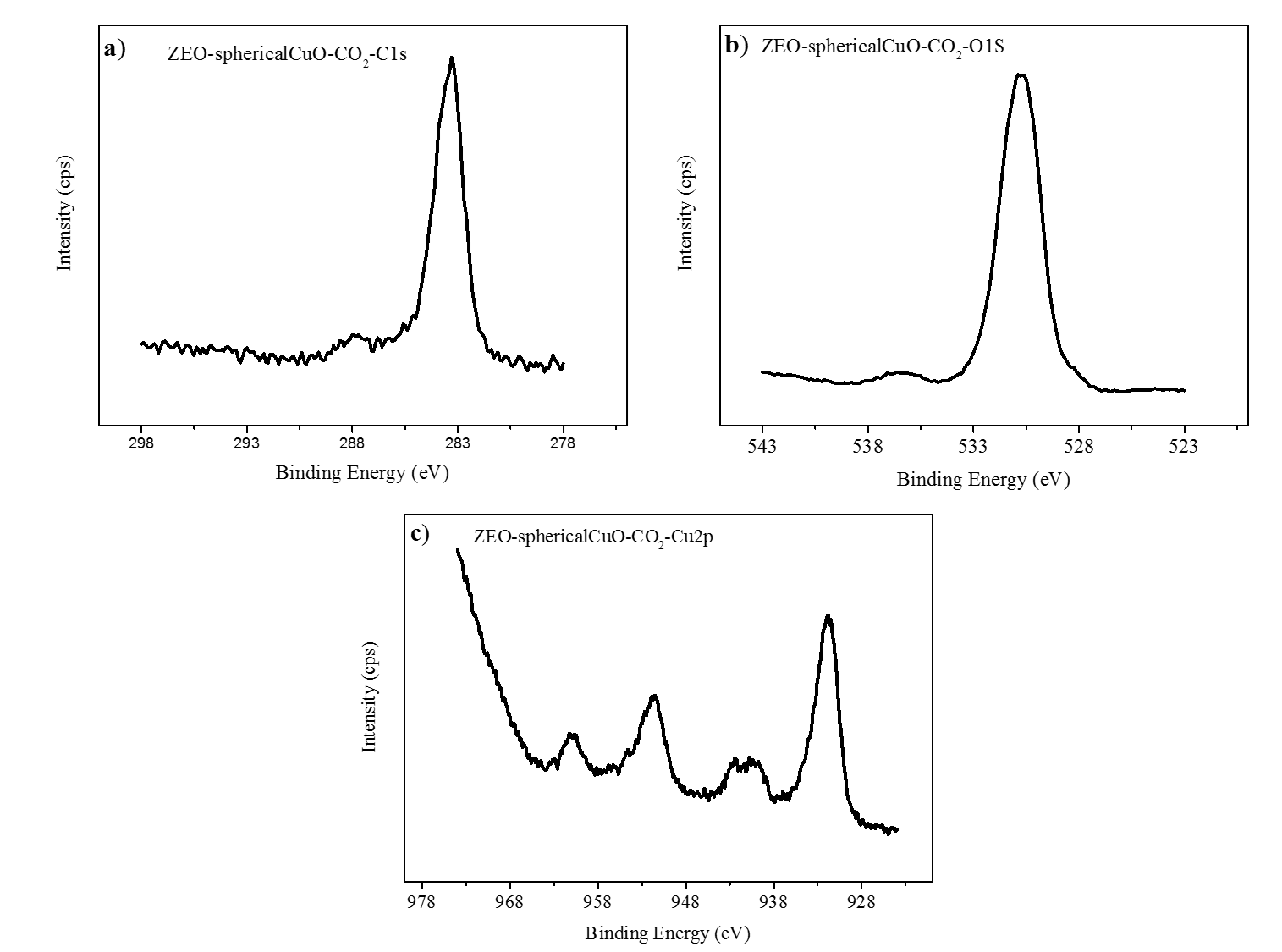


FIG S7. XPS spectra of spherical CuO NPs on zeolite after CO2 treatment: a) C1s, b) O1s, c) Cu2p.

**Quantitative analysis of CO2 adsorption by FTIR analysis:**

The infrared light absorption of CO2 in gas form is proportional to its concentration in the N2-CO2 gas mixture according to the Beer-Lambert Law.

*A= Ɛ.l.c*

Here *A* is absorbance, *Ɛ* is absorptivity, *l* is the path length and *c* is the concentration of the CO2. Thus, a ratio of two absorbance becomes a ratio of the CO2 concentrations in two different samples while the path length is kept constant:

*A1 / A2 = c1 / c2,*

Since concentration is proportional to the number of CO2 molecules:

*c = (N/NA)/V*

The absorbance ratio directly becomes ratio of the number of CO2 molecules

*A1 / A2 = N1/N2*

Thus, the ratio directly shows relative loss of the CO2 in the sample compartment, which then can be correlated to the absorbed amount of gas at the substrate surfaces when the reference N2-CO2 mixture is used. This enables one to calculate the percentages of adsorbed CO2 per gram of substrate for all samples.