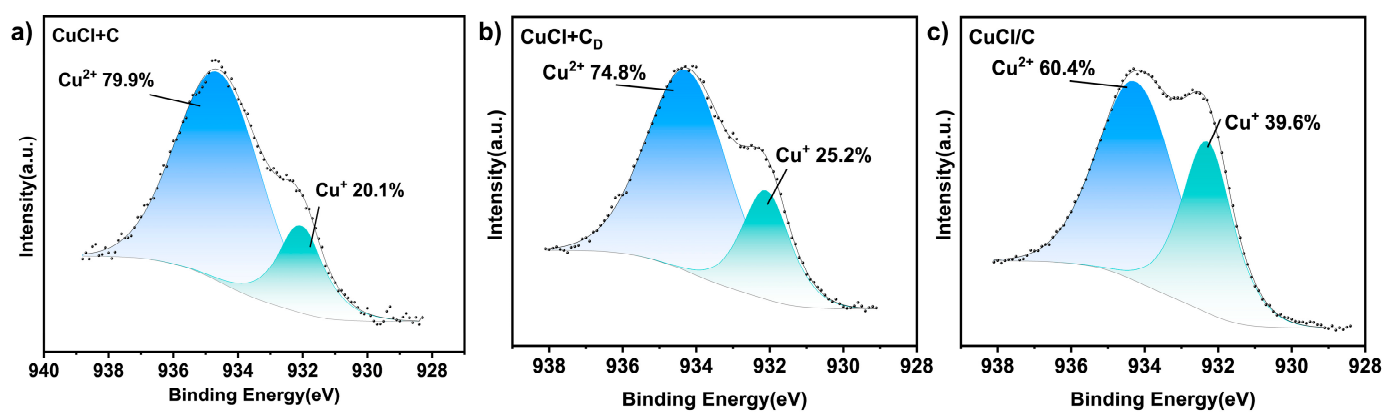


**Figure S1.** a) SEM image of CuCl+C. b) SEM image of CuBr+C. c) SEM image of CuI+C. The light bulks in the image represent copper compounds, and the dark bulks represent activated carbon



**Figure S2.** XPS of 5%CuCl+C, 5%CuCl+C<sub>D</sub>, and 5%CuCl/C

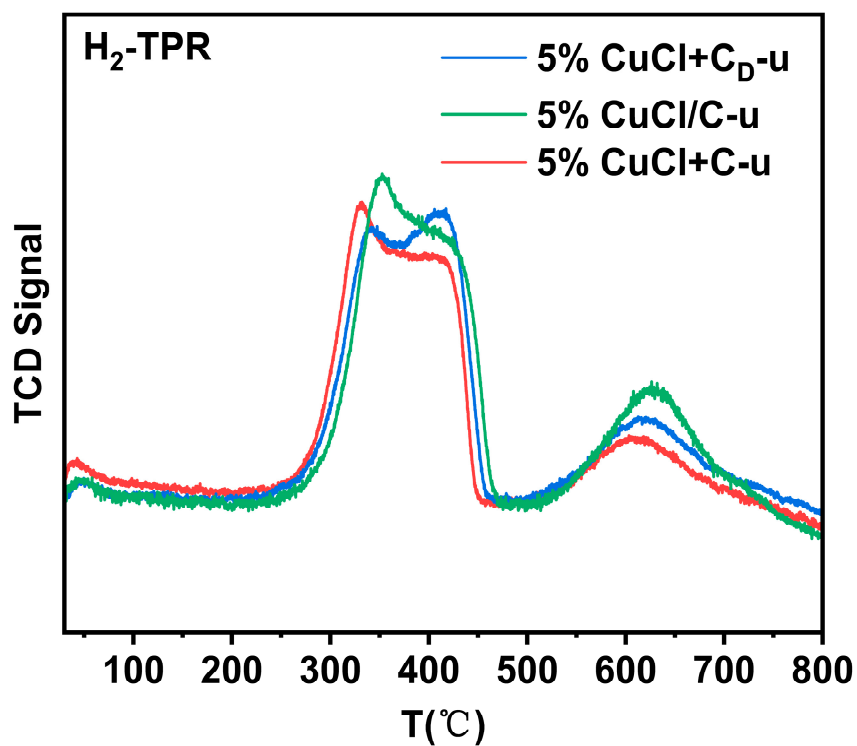


Figure S3. H<sub>2</sub>-TPR of 5%CuCl+C-u, 5%CuCl+C<sub>D</sub>-u , and 5%CuCl/C-u

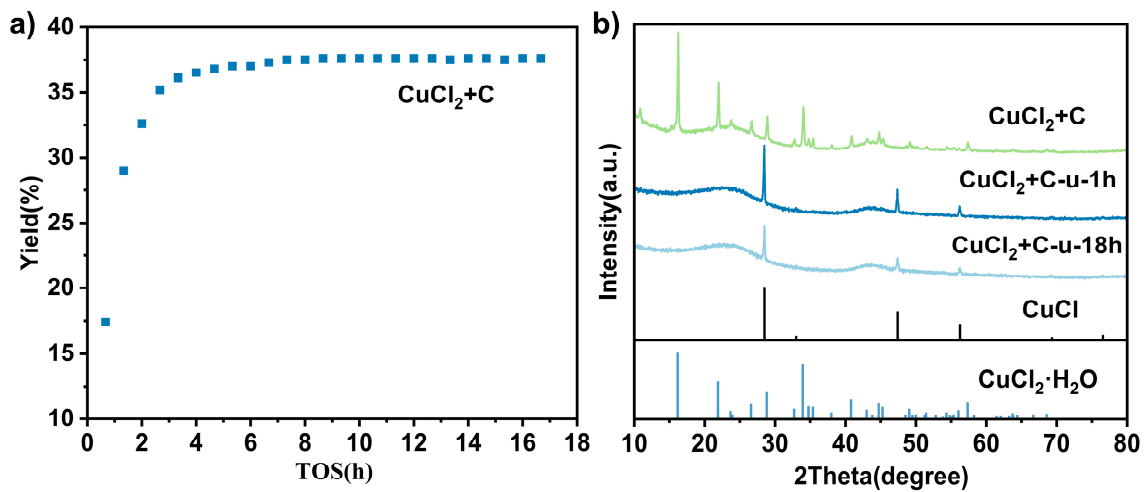


Figure S4. a)The catalytic performance of CuCl<sub>2</sub>+C b)The XRD of 5%CuCl<sub>2</sub>+C