Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Simple physical preparation of single copper atom on amorphous carbon via Coulomb explosion

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Effect of surface morphology of copper particles on Coulomb explosion. The Coulomb explosion mechanism of copper particles with irregular shapes under electron beam irradiation was investigated using in-situ transmission electron microscopy (TEM). The results are shown in Fig. S1. For irregular copper particles, Coulomb explosion can also occur under the same experimental conditions (Fig. S1(a)-(d)). Copper single atoms can also be prepared using this method. Therefore, the surface morphology of the original material has a negligible effect on Coulomb explosion.

Coulomb explosion of aluminum. The Coulomb explosion mechanism of aluminum particles under electron beam irradiation was investigated using in-situ TEM, and the experimental conditions were the same as in the main text. The results are shown in Fig. S2. Before the Coulomb explosion (Fig. S2(a)), the aluminum particles are irregular. At the early stage of Coulomb explosion under electron beam irradiation, the two aluminum particles quickly form a larger particle. The tearing and chromatic aberration of the carbon film around the aluminum particles indicate that the sample has undergone a Coulomb explosion. This phenomenon is more pronounced as the electron beam irradiation duration increases (Fig. S2(b)). The HAADF image was acquired after Coulomb explosion at a distance of approximately 40 μm from the aluminum particles. The amorphous carbon film had distinct aluminum single atoms (Fig. S2(c)). The EDS spectra of the regions labeled I-III are shown in Fig. S2(a), (b). The spectra show that aluminum signals are detected in and around the particle before and after the Coulomb explosion (Fig S2d). Therefore, Coulomb explosion can occur in general metals, and this work will provide new ideas for the universal simple physical preparation of MSA catalysts.

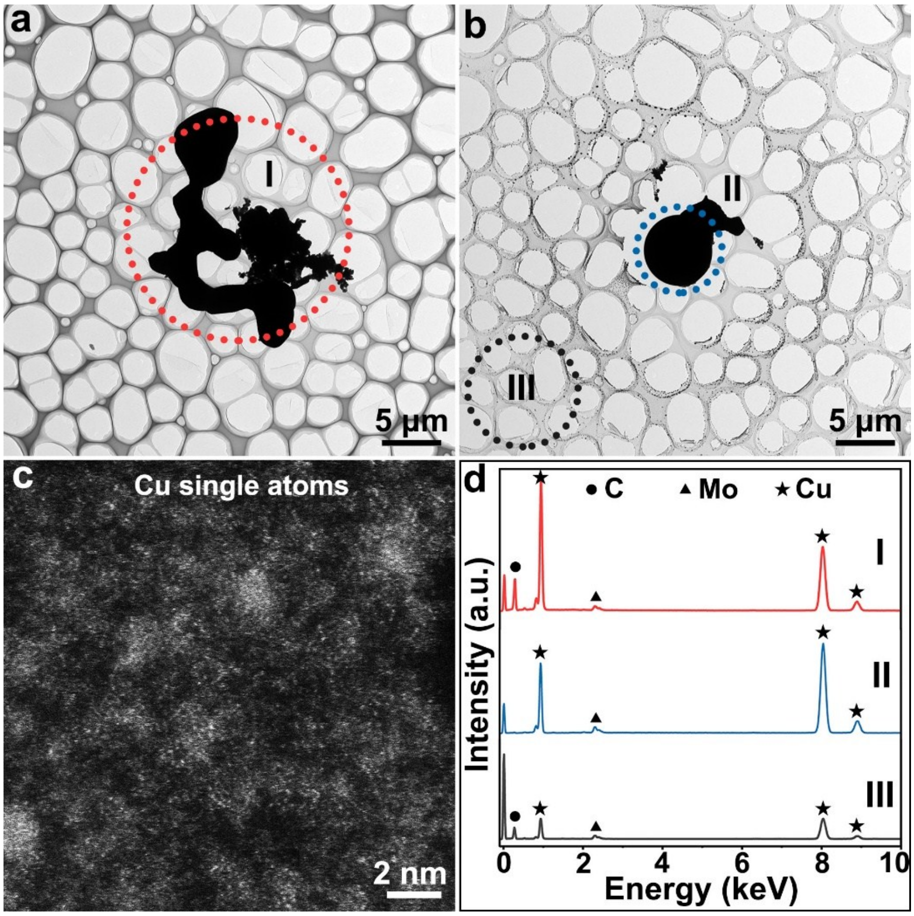

Fig. S1 TEM micrographs of copper nanoparticles with irregular shapes undergoing Coulomb explosion. (a) before Coulomb explosion; (b) after Coulomb explosion; (c) HAADF image of copper single atoms. (d) EDS spectra of the regions labelled I-III in (a) and (b). The Mo signal is derived from the Mo grid with the ultra-thin carbon film.

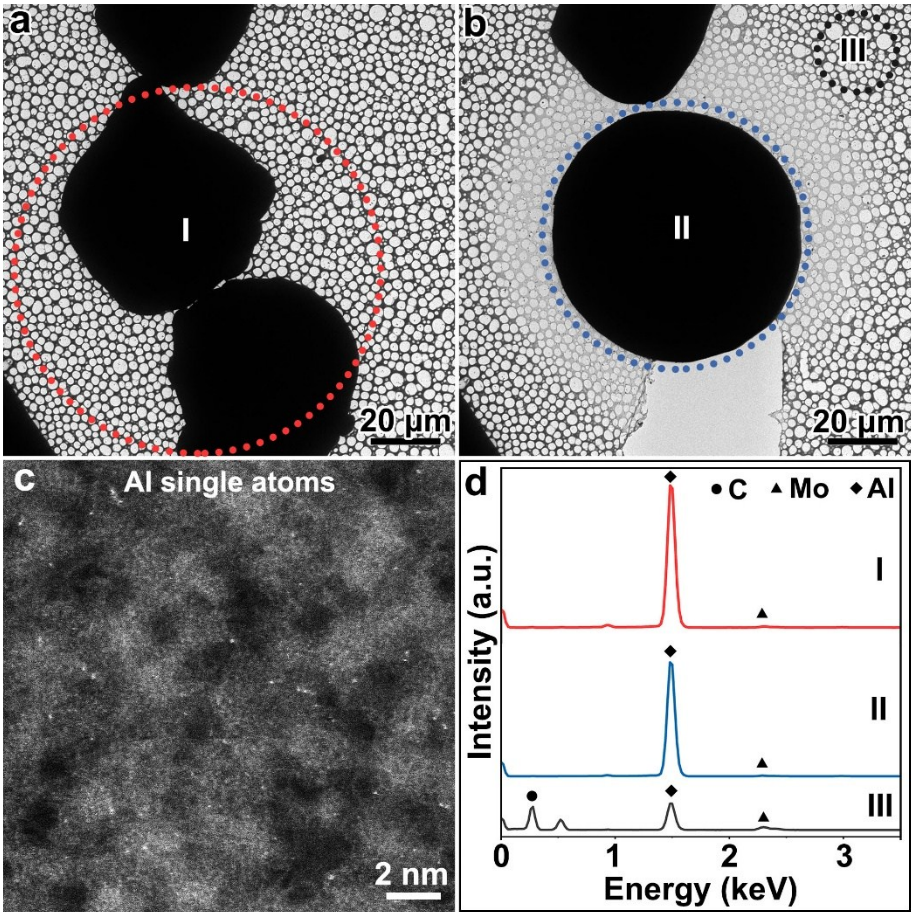

Fig. S2 TEM micrographs of aluminum nanoparticles undergoing Coulomb explosion. (a) before Coulomb explosion; (b) after Coulomb explosion; (c) HAADF image of aluminum single atoms. (d) EDS spectra are from regions I-III labelled in (a) and (b), respectively. The Mo signal is derived from the Mo grid with the ultra-thin carbon film.