

Quantification of 3D particle morphological changes during the sintering process of Cu powder using in-situ X-ray CT

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Understanding the true sintering mechanism of metal powders in the initial-stage remains challenging because most experimental and numerical studies rely on two-dimensional observations, which cannot fully capture the three-dimensional (3D) arrangement and topological evolution of particles. Recent in-situ X-ray computed tomography (CT) studies have enabled direct 3D observation of sintering processes; however, quantitative descriptions of early-stage sintering kinetics in three dimensions remain limited.

In this study, in-situ synchrotron X-ray CT was applied to observe the 3D morphological evolution of gas-atomized Cu powder compacts during the initial stage of sintering. Time-resolved CT measurements were performed during heating up and isothermal holding at 1073 K, and three-dimensional image analysis was conducted to quantify relative density and neck topology within an observation volume. Persistent homology was employed to define particle sizes, neck diameters, and number of contacts in three dimensions.

The results show that relative density decreases during heating up to 1073 K due to thermal expansion, followed by gradual densification during the isothermal holding. During ramp-up, the average neck diameter increased while the number of necks decreased, whereas the opposite trend was observed during isothermal holding. These behaviors indicate that particle rearrangement and coordination changes play a dominant role in the initial stage of sintering.

Professional Status of the Speaker

Senior Scientist

Interest in submitting a paper in a special issue of

Journal of the European Ceramic Society (Elsevier)

Invitation letter for visa

Yes

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