**A verified open-access AI-based chemical microparticle image database for *in-situ* particle visualization and quantification in multi-phase flow**

This work provided a new method and idea for the detection, identification, classification, and quantitative analysis of four dispersed phase particles (agglomeration, bubble, crystal, and droplet) in chemical multi-phase flow. Firstly, an open-access chemical microparticle image database (CMD) with 2,500 labeled particle images was established and augmented – “Open-CMD”, containing more than 50,000 particles (four classes, different sizes, and shapes). After that, the advanced original Mask R-CNN model was trained, fine-tuned, and called MicropNet+. The evaluation of model in terms of internal and external metrics demonstrated that MicropNet+ had an efficient, accurate, and amazing ability to identify and classify dispersed phase particles.