|  |
| --- |
| **Mix Reactive Droplet in a Powder Bed(14 Bold)**  **Ting-Yu Cheng1, Pankaj Doshi2 and Ying-Chih Liao1,\* (10 Bold)**  1 Department of Chemical Engineering, National Taiwan University, Taipei City, Taiwan  2 Worldwide Research and Development, Pfizer Inc., Groton, CT  Email of corresponding author: liaoy@ntu.edu.tw  (10 regular) |

**Abstract (12 Bold)**

Among all 3D printing technologies, binder-jetting is famous for printing multiple materials simultaneously with multi-nozzles, and thus is convenient to integrate several elements in a single manufacturing process. Standard binder-jetting procedure prints glue inks on powder layer to bind powder particles together. By printing epoxy inks with curing agents (or so-called AB glues) from separate nozzles simultaneously on powder, the printed objects can yield in high mechanical strength after curing. Therefore, the distribution of the two inks in powder and the reaction extent are critical to the printing resolution and mechanical properties. Because it is technically difficult to observe fluid flows in powder experimentally in the binder-jetting process, a computational fluid dynamics (CFD) approach is used in this study to explore capillary flows in between micron-size particles. A CFD model is developed to describe the mixing and reaction of two chemical components in the capillary flow inside the powder bed using a commercial software, Flow-3D. Two droplets, one carrying expoxy ink and the other containing curing agents, fall onto and penetrate into a powder bed of micron-size particles. After droplet impact and spread over the particles, flows driven by capillary force causes the liquid gradually penetrate into the void space in the powder bed. The capillary flow of the two adjacent droplets leads to mixing and reaction between the two chemical species carried by separate droplets. The degree of mixing and reaction extent of the AB glue will be optimized by alternating droplet velocity, the relative positions of droplets, and the hydrophilicity and sizes of powder particles. In summary, this study will provide a general guideline to optimize the mixing of inks in powders, and can be further apply to improve the printing quality of printed objects from binder-jetting.



**Figure 1 ICFPE2024**

**Keywords (10 Bold):** (Up to five key words) (10 regular)

**References (10 Bold)**

1. Liu, Z., et al., Capillary drop penetration method to characterize the liquid wetting of powders. *Langmuir*, 2017. 33(1): p. 56-65.
2. Wu, M., S. Radl, and J.G. Khinast, A model to predict liquid bridge formation between wet particles based on direct numerical simulations. *AIChE Journal*, 2016. 62(6): p. 1877-1897.

[Notice] The length of the abstract MUST BE within one page.