Multiple and High-throughput Micro-droplet Reactions

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Micro-droplets offer unique compartments for accommodating a large number of chemical and biological reactions in tiny volume with precise control. A major concern in droplet-based microfluidics is the difficulty to individually address droplets and achieve high-throughput at the same time. Here I will present an improved the cartridge sampling technique combined with a microfluidic chip to perform droplet screenings and aggressive reaction with minimal (nL) reagent consumption. The droplet composition, distance, volume (nL to sub-nL), number and sequence could be precisely and digitally programmed through the improved sampling technique, while sample evaporation and cross-contamination are effectively eliminated. Moreover, a new functional material, RAP, has been developed for 3D temperature monitoring of microfluidic chip. Outstanding solvent, thermal stability and photo stability of this material permits accurate and rapid temperature measurement of local temperature surrounding an nL droplet trapped inside a RAP chamber. This new thermometric methodology is sufficient to characterize vigorous reaction in nL droplet which is much safer and later on recognized that behave distinctively from bench-top size experiments in mL volume. In summary, our combined device provides a simple model to utilize multiple droplets for various reactions with low reagent consumption and high-throughput.