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Droplet microfluidics for phase transitions as functions of temperature and relative humidity[1] PRIYATANU ROY, CARI DUTCHER, University of Minnesota — Phase state of complex multiphase liquid droplets such as atmospheric aerosols, spray coatings or biological fluids are dependent on the temperature and relative humidity (RH) of the surrounding environment, with large implications in climate modeling, coating processes or biomedical applications. We present droplet microfluidic platforms for studying phase transitions as functions of these parameters for phase separation and crystallization at above and below freezing point for multiphase liquid droplets. Some ternary droplets showed temperature, droplet solute concentration and organic to inorganic solute ratio dependence of phase transition at temperatures down to -20C in static traps. Equilibrium thermodynamic models were used to translate the droplet solute concentration to RH relevant to control systems. Droplet freezing experiments were conducted on a platform with a controllable temperature gradient and a flow-through microfluidic channel. Rapid detection of freezing was attempted with polarized optics utilizing birefringence of droplets ice crystals, and a deep neural network to classify frozen vs. liquid droplets with high accuracy. These platforms will enable phase transitions studies of environmental droplet samples in the future.

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