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Temperature and Thermal Equilibrium States in Bubbles with Varied Bubble Size and Discharge Energy KUNPENG WANG, CHRISTOPHER CAMPBELL, XIN TANG, SHARIFUL BHUIYAN, ABDULLAH BAKY, DAVID STAACK, Texas AM Univ — To optimize plasma-liquid interaction in non-thermal plasma processing of liquids with gas bubbles, we studied the effects of bubble size and discharge energy on temperature and product distribution at equilibrium states in bubbles and seek to control them by varying bubble size and discharge energy. Pulsed energy deposition to methane bubbles was simulated as a constant volume heating process with varied gas heat capacity and compositions. Energy deposition process is highly non-equilibrium and takes place at a time scale of 100-200ns. Gas temperature based on the deposited energy was evaluated. Reaction kinetics and species distribution at this temperature were studied by assuming at thermodynamic equilibrium. Reaction kinetics in methane bubbles showed when temperature is 1500K, it takes about 150ms to reach an equilibrium state. C2 species is highly concentrated and might lead to solid production. At 2500K, the time for equilibrium is only 5us and more C2 species were present in the bubble. Smaller bubbles will have higher temperature for the same energy deposition. Energy deposition to 0.5mm bubbles should be less than 3.5mJ to keep bubble temperature below 1500K. If bubble size is less than 0.2mm, deposition energy needs to be smaller than 0.5mJ to make temperature less than 1500K. Low temperature is preferred because it produces less C2 products and allows longer plasma liquid interaction time.

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