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Modeling the direct injection of liquid droplets into low-pressure environments and plasmas I. SARAF, M. GOECKNER, L. OVERZET, UT Dallas — A model for the evaporation of micron-sized liquid droplets injected into low pressures and plasmas is being developed. This model differs from higher pressure models in that it assumes the mean free path is greater than the droplet diameter and therefore allows one to assume that the transport is non-diffusive. The model accounts for both particle and heat flux into and out of the droplet (by collisions with gas molecules, evaporation and the return of molecules {freeze-on}). With the addition of plasma, several other terms are added (ion bombardment, recombination etc.). The model runs in Matlab and indicates that the time required for the droplet to fully evaporate is a function of the background pressure, initial (wall) temperature, the number of droplets inserted simultaneously and initial size. A typical evaporation time for a 50 micron diameter droplet is 7 seconds for hexane and up to 25 seconds for ethanol without plasma. Upon insertion into the low pressure environment, the temperature of the droplet decreases quickly as the first few microns evaporate. The temperature falls to a minimum value, generally below the freezing point where the heat flow balances. This sets the evaporation rate and explains why the evaporation time decreases with increasing the pressure, the number of droplets and the initial droplet temperature. Supported in part by SPRING/AFOSR Grant FA9550-05-1-0393.

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