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Advances in Fundamental Materials Research

# Vapor Pressure Measurements from Droplet Evaporation Rates of Low-Volatile Materials

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We describe an experimental arrangement for studying individual suspended micro-droplets that directly measures droplet size in real time with high precision, this allows accurate values of evaporation rates to be recovered. The experimental system uses a linear electrodynamic quadrupole (LEQ) with optical feedback to suspend microdroplets and hold them stationary. The LEQ is enclosed to permit a gas flow over the suspended droplets, and the entire system is contained in a precisely controlled environmental chamber so that temperature, relative humidity, and surrounding gas species become experimental variables. This unique experimental capability provides a means for determining basic molecular properties for chemicals of interest.

Fundamental computational models of droplet evaporation depend on values for both the vapor pressure of the droplet material and the diffusion coefficient of the molecular vapor into the surrounding atmosphere. [2, 3] These specific thermodynamic properties can be difficult to independently measure accurately as bulk material properties using conventional methods, especially for compounds with low vapor pressures.

Our experimental method is based on a previously demonstrated method [4] by which vapor pressure and diffusion coefficient can be inferred from the model equations using measured droplet evaporation rates under different environmental conditions. Our experimental evaporation rate data has sufficient precision that it can provide accurate determinations for both the vapor pressure and vapor diffusion coefficients of the droplet material. This method is quite general, and can be applied to fill data gaps on relevant chemical compounds that are needed for accurate hazard prediction and consequence management models. We will summarize our latest results on droplet materials including CW simulants such as pinacolyl methylphosphonate (PMP).

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*Support from the Defense Threat Reduction Agency Joint Science and Technology Office is gratefully acknowledged.*