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VOLATILITY AND PHASE TRANSFORMATION OF AQUEOUS NITRATE DROPLETS

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The hydration and crystallization of aqueous solution droplets containing alkaline-earth metal nitrates: $Mg(NO_3)_2$, $Ca(NO_3)_2$, $Sr(NO_3)_2$ and $Ba(NO_3)_2$, were systematically investigated in a single-particle levitation apparatus under controlled humidity conditions. Laser Raman and Mie scattering techniques were used to probe the chemical and physical state of a microparticle before and after phase transformation. New solid metastable states, whose presence is not predicted from bulk-phase thermodynamics, were found to form when highly supersaturated solution droplets solidified. It was also observed that a solution droplet containing either $Mg(NO_3)_2$ or $Ca(NO_3)_2$ would steadily lose its mass when left in the water vapor for an extended period of time. A plausible explanation is that gaseous HNO_3 was volatilizing from the droplet, leaving behind $Mg(OH)_2$ or $Ca(OH)_2$, which precipitated out because of their low solubilities in water. The origin of material loss in droplets, which until now has been observed to occur only in particles containing volatile solutes such as NH_4NO_3 and NH_4Cl, will be elucidated and reported.