Fourier transform infrared (FTIR) spectroscopy was used to investigate gas-phase suspended molecular particles and composites in the nano- and micrometer size range. The particles were generated by a recently developed collisional cooling technique with an integrated multiple-reflection White optics. Due to the relatively large optical pathlength of up to 20 m, the detection sensitivity of the system is high enough to apply rapid-scan FTIR spectroscopy for investigation of the formation process of molecular nanoparticles growing by desublimation of supercooled molecules and of further evolution of the particles. Intermediate temperatures can be adjusted with an accuracy of better than ± 0.4 K in the temperature range of 4 to 400 K. As a consequence, phase transitions of the particles can be investigated. As a main topic of the talk, self-diffusion in core-shell composite nanoparticles is presented. Furthermore, bigger water ice particles generated and suspended in stationary acoustic fields are discussed. For size and shape analysis of the particles, we use the Discrete Dipole Approximation (DDA) method which calculates the scattering and absorption parts of the extinction spectra.