Spectroscopy of Free-Floating Planetary-Mass Objects and their Disks with JWST

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Free-floating planetary-mass objects (FFPMOs) in star-forming regions represent the low end of the stellar initial mass function and overlap in mass with the high end of the exoplanet population. As such, they share characteristics with both brown dwarfs and giant planets. We will present new findings on eight FFPMOs from near- and mid-infrared spectroscopy using the NIRSpec and MIRI instruments on the James Webb Space Telescope. We derive fundamental properties of these targets, and find spectral types of M9.5 to L4, with effective temperatures of 1900-1600 K. The photospheric spectra of our targets clearly show a diversity at similar temperatures, especially in the 3-5 micron range, not accounted for by current atmosphere models. We find silicate absorption features in the photospheres of two of our targets, the first such detections in very young FFPMOs, indicating silicate clouds in their cool atmospheres. The remaining six objects show mid-infrared excess emission above the photosphere, as well as silicate emission features, demonstrating the presence of dusty disks. The shape and strength of the silicate features constitute strong evidence of grain growth and crystallization, similar to what is seen in young brown dwarfs and stars. We also detect emission lines from hydrocarbon molecules in the disks of several targets most notably Cha 1107-7626, which shows unambiguously methane and ethylene lines as well as hydrogen recombination lines, the latter implying ongoing accretion. Its disk spectrum looks remarkably similar to that of a very low mass star with a carbon-rich disk, and a model assuming gas temperatures of a few hundred Kelvin in the inner disk can account for its hydrocarbon lines. These are the lowest mass objects found so far with silicate and hydrocarbon emission features arising in their disks, and are worthy of follow-up spectroscopy at high resolution.