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Transition flow of binary gas mixtures through small sampling orifices RAINER JOHNSEN, University of Pittsburgh, MIRKO VUKOVIC, Tokyo Electron US Holdings — Low-temperature plasma experiments often sample the gas mixture through a small orifice into a differentially-pumped mass spectrometer or other instruments. If gas mixture flow through the orifice is either in the molecular regime or in the transition regime between molecular and hydrodynamic flow, the relative concentrations of the gases in the mass spectrometer can differ significantly from that in the plasma chamber. The degree to which this occurs is poorly known from theory or experiment. We present results of ion-drift-tube measurements, in which ion-molecule reactions are used to determine the variation of the number density of a minority molecular gas as a function of the flow rate of a lighter or heavier atomic carrier gas. We find that the concentration of a heavier minority gas declines strongly with increasing carrier gas flow, while the effect is less pronounced when the minority gas is composed of molecules lighter than the carrier gas atoms. A semi-empirical formula, written in terms of the rare-faction parameter (essentially the reciprocal of the "Knudsen number"), reproduces observations fairly well and may be a useful estimating tool. We are trying to develop more rigorous Monte Carlo computer code to the gas mixture flow through the orifice.

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