POTASSIUM LINESHAPE STUDY WITH COLLISIONAL PARTNERS OF NITROGEN, HELIUM, AND HYDROGEN

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Potassium can be used as a convenient tracer species in combustion and hypersonic test facilities and is naturally present in trace amounts in the atmospheres of brown dwarfs, where the resonance doublet is highly detectable. Currently, there are no experimental data of potassium lineshape parameters at temperatures over 500 K and model predictions vary widely above 1000 K. We present measurements of collisional broadening and pressure shift parameters for the potassium D-lines, near 770 nm, with collisional partners of N_2, He, and H_2. Atomic potassium is generated in a shock tube by shock heating KCl salts at temperatures between 1100-1900 K, and line parameters are measured using rapid-scanning tunable diode laser absorption spectroscopy. The lineshape measurements were modeled as Voigt profiles and a fitting algorithm determined pressure shift and collisional full-width-at-half-maximum. The collisional broadening and pressure shift coefficients are given as temperature-dependent power-law relations for the partners of interest. The helium and hydrogen results agree with lower temperature experimental data, within 15-20%, and high-temperature theoretical predictions, within 10-30%. The nitrogen results, however, have larger discrepancies with existing data and simplified impact theory predictions. This may suggest the need for a more detailed model for the nitrogen collisional broadening of potassium. The presented correlations may be useful for the development of potassium-based sensing methods with application to combustion, hypersonics, and astrophysics.