INVESTIGATION OF THE ROTATIONAL SPECTRUM OF BiO IN THE $X^2\Pi$ ELECTRONIC STATE

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A recent, far reaching study of the BiO radical by Shestakov et al.\(^a\), has provided spectroscopic constants for a total of nine of its electronic states. The rotational constants calculated for the $X^2\Pi$ state have been used as the basis for a further investigation by microwave spectroscopy at Nobeyama Radio Observatory. BiO was produced in a flow system by heating Bi to 1120 K in a Knudsen cell and reacting the resulting vapor with an approximately 1:1 mixture of O\(_2\) and Argon in the presence of a dc discharge.

A useful side-effect of this method of production is the population of highly excited vibrational states of BiO. This is presumably due to collisional energy transfer from the metastable $a^1\Delta_g$ electronic state of O\(_2\). As a result, rotational transitions within vibrationally excited levels up to $v = 9$ in the $X_1^2\Pi_{1/2}$ electronic state and $v = 5$ in the $X_2^2\Pi_{3/2}$ state have been observed. A sample microwave spectrum of the BiO radical is given in Figure 1, which illustrates the hyperfine pattern that is associated with the presence of the $I = 9/2$ \(^{201}\)Bi nucleus. Thus far, a total of 575 lines have been assigned and fitted with an RMS of 27 kHz, using an effective Hamiltonian similar to that of Brown et al.\(^b\). There is excellent agreement between the microwave parameters and those obtained in the optical study. In addition, the hyperfine parameters for both the $X_1$ and $X_2$ electronic states have been determined.