Spectrum of High Frequency Discharge in Air in Relation to Active Nitrogen

N. R. TAWDE AND G. K. MEHTA
Royal Institute of Science, University of Bombay, Bombay, India
February 16, 1946

HAYES, Winans, and Culp[1] have recently reported some interesting observations on the effect of the excitation frequency on the spectra of gaseous discharges. The spectrum of commercial argon-filled bulbs at lower frequencies (50 c) mainly consisted of the violet second positive bands of nitrogen, and at higher frequencies (10 mc) the first positive bands were found with high intensity giving the discharge an orange color. This effect could not be noticed in tubes containing pure nitrogen. Similar results[2] were obtained in these laboratories while working with high frequency discharge in air at frequencies ranging from 5 to 15 mc. The relative changes in intensities of the two band systems of nitrogen which are responsible for the change in color of the discharge could be obtained by changing any one of the three parameters, i.e., the pressure, frequency, and voltage of excitation. This clearly shows that the intensity changes are the consequences of the change in velocity of the exciting electrons with change in any discharge parameter. The quantitative spectroscopic study of these intensity changes in air has been done by Asundi and J. Singh[3] where they have also observed a relative intensity change in the two band systems of nitrogen with the change in excitation frequency. According to Brasefield's[4] simplified picture of the h.f. discharge, an increase in the excitation frequency will result in a decrease in the electron velocity which will facilitate the production of spectra requiring smaller excitation energy, i.e., the first positive band system. A detailed study of the variations of the electron velocities with the other parameters of the discharge is in progress in these laboratories and the results will be communicated soon.

The absence of the phenomenon of change of intensity with the change in the frequency of excitation in pure nitrogen can be explained by the results of Tawde and Patankar[5] derived from altogether independent spectral study. They have investigated the rôle of impurities particularly of the rare gases like argon in the spectra of nitrogen by quantitative intensity measurements. Their study is confined to the comparison of the intensity distribution in the nitrogen molecular spectra obtained from (1) discharge in air and (2) in pure nitrogen, under identical conditions. It was found that the nitrogen spectra in air, i.e., the first positive and the second positive band systems are very much susceptible to relative changes in intensities as compared to those in pure nitrogen. This may be attributed to the production of active nitrogen under the influence of argon, the major rare gas constituent of air. The exact role played by foreign gases is still a matter in dispute, but in the light of the observations in the h.f. discharge and the results of Tawde and Patankar,[5] it appears that the foreign gas acts in such a way as to accelerate the formation of excited molecules or to retard the rapid reversion of active nitrogen. This may be taken as an evidence for the possible presence of active nitrogen in the h.f. discharge in air.

[1] K. J. Hayes, J. G. Winans, and W. Culp, Phys. Rev. **68**, 98 (1945).
[2] N. R. Tawde and G. K. Mehta, Proc. Ind. Acad. (to be published).
[3] Asundi and J. Singh, Proc. Ind. Acad. Sci. **22**, 60 (1945).
[4] C. J. Brasefield, Phys. Rev. **35**, 92 (1930).
[5] N. R. Tawde and V. S. Patankar, Phil. Mag. **35**, 616 (1944).