Fast processes in a N2O-modulated hollow cathode discharge: Excitation and diffusion

Abstract: In this work the changes in the infrared absorption of N2O observed in a hollow cathode discharge modulated by a 45 Hz square wave are studied by time-resolved infrared absorption spectroscopy, with a Fourier transform infrared (FTIR) spectrometer working in the step-scan mode. These variations are attributed to alternative population and depopulation of the ground state of N2O; on the other hand, no changes are observed in the total concentration of N2O and the major products of the discharge. The experimental results are explained by means of a simple kinetic model: vibrational excitation processes are assumed to be the main cause of the observed effects, but an inhomogeneous distribution of the stable species and the incorporation of diffusion terms between the plasma volume and the rest of the discharge cell are shown to be crucial in order to justify the quick and sharp variations in the N2O ground-state population seen along the path of the IR beam. The influence of these effects has been verified also by mass spectrometric measurements of the temporal behavior of the concentration of the major products N2O, N-2 and O-2 at one end of the discharge cell and at different frequencies.