

0.4 eV [5, 6]) of another spin subband of nickel to the exchange-unsplit impurity band.

We have thus presented direct experimental proof of the appearance, in a binary disordered alloy with small impurity concentration, of a relatively narrow impurity band localized near the edge of the ground-state band. In addition, observation of the interband density of the optical transitions into the impurity band provides a good method of investigating the curve of the density of states of the main metal, which is suitable for both ferromagnetic and non-ferromagnetic alloys.

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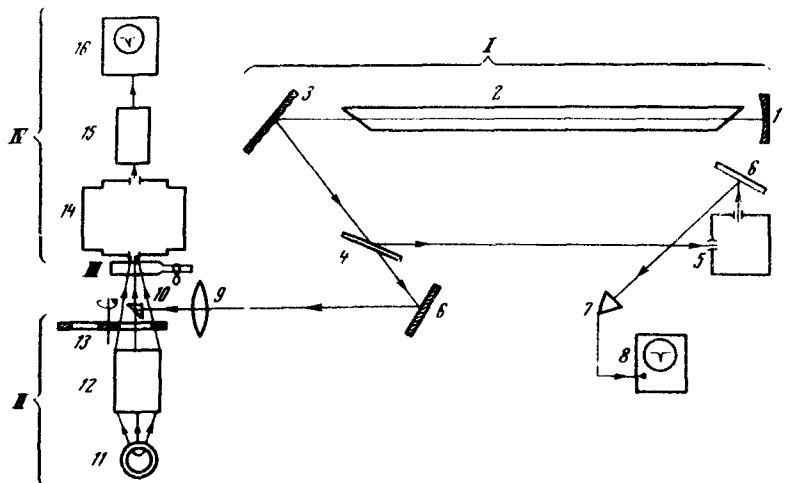
#### TWO-STEP PHOTODISSOCIATION OF AMMONIA MOLECULES EXCITED BY LASER RADIATION

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1. We report here the first observation of two-step photodissociation of molecules excited by laser radiation. Two-step photoionization and photodissociation processes in atoms and molecules are considered in [1, 2] from the point of view of the selective action of laser radiation on matter. In the two-step photodissociation scheme, the monochromatic laser radiation excites selectively the molecules to the vibrational or electronic level (in this case, the vibrational level of the NH<sub>3</sub> molecule) and the simultaneously excited molecules are

Fig. 1. Experimental setup:

I - Pulsed CO<sub>2</sub> laser with transverse discharge (1 - total-reflection mirror of resonator (R = 10 m), 2 - laser tube, 3 - diffraction grating, 4 - plane-parallel plate, 5 - IKM-1 monochromator, 6 - mirrors, 7 - IR receiver, 8 - oscilloscope, 9 - lens (F = 200 mm), 10 - rotating prism). II - UV radiation block (11 - hydrogen lamp, 12 - condenser, 13 - modulator). III - Cell with ammonia. IV - Recording system (14 - MDR-2 monochromator, 15 - photomultiplier, 16 - oscilloscope).



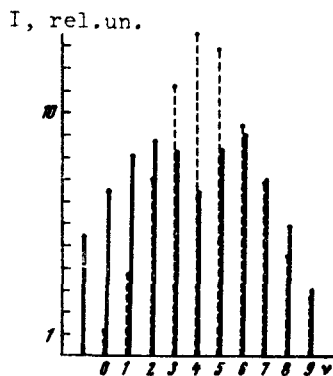


Fig. 2

Fig. 2. Electron-vibrational absorption spectra of  $\text{NH}_3$  molecule at room temperature (dashed) in the case when 50% of the molecules are at the first vibrational level.

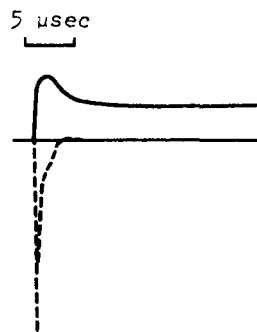


Fig. 3

Fig. 3. Superimposed (in time) pulses of the  $\text{CO}_2$  laser (downward spike) and of absorption on the second line (upward spike).

illuminated with light whose quantum energy is insufficient for photodissociation of the molecule from the ground state, but is sufficient for photodissociation from the excited level.

2. The experimental setup is shown in Fig. 1. The radiation of a  $\text{CO}_2$  laser with a transverse discharge (I) [3] was directed to a cell with ammonia. The wavelength of the  $\text{CO}_2$  laser was varied by rotating the diffraction grating and tuned to the  $10.6\text{-}\mu$  P(32) line of the  $\text{CO}_2$  gain band. Laser radiation at this wavelength is effectively absorbed already at ammonia pressures of 20 Torr. The pulse energy was 50 - 60 mJ. The  $\text{CO}_2$  laser beam in the cell was slightly focused by a lens, so that the illuminated volume was  $0.15\text{ cm}^3$  at a cell thickness 1 cm.

A DMR-2 monochromator (14) was used to investigate the absorption spectrum of the ammonia in the  $2200\text{-}\text{\AA}$  region. The electronic absorption spectrum of the unexcited ammonia in the  $\tilde{A} - \tilde{X}$  band consists of several sharp absorption lines spaced  $850\text{ cm}^{-1}$  apart (Fig. 2). It is known that the transition of the ammonia molecule into the electron-excited state leads to dissociation of the molecule [4]. Figure 2 shows also the absorption spectrum of ammonia, calculated in accordance with the data of [5], for the case when 50% of the particles are at the first vibrational level  $v' = 1$ . It is seen from Fig. 2 that the population of the first vibrational level leads not only to a change of the absorption line intensities, but also to the appearance of a new long-wave absorption line.

3. The purpose of the experiment was to observe a new predissociation line in the ammonia absorption spectrum when the molecules are pumped by laser radiation. Figure 3 shows, superimposed, the laser radiation pulse and the pulse of the resultant absorption in the UV region at the new absorption line ( $v' = 1 \rightarrow v'' = 0$ ). Owing to the fast vibrational relaxation, the vibrational excitation is thermalized within a time on the order of the laser-pulse duration, and the population of the first vibrational level is maintained at the level of the Boltzmann distribution. Estimates of the gas temperature after the vibrational relaxation show that 17 - 19% of the particles are located on the first vibrational level, as a result of the thermal population. It is seen from Fig. 3 that the amplitude of the initial part of the absorption pulse, the duration of which corresponds to a laser-pulse duration approximately 2.5 times larger than the amplitude of the "tail," indicating that the laser radiation transfers

to the vibrational level  $v' = 1$  approximately 45% of the particles. It must be noted that the pumping of the ammonia occurs through one vibrational-rotational transition of the molecule. Direct measurements of the absorption of infrared light in ammonia also show that 45% of the particles are at the upper vibrational level. Thus, during the course of the  $\text{CO}_2$ -laser pulse, the molecules excited by the laser radiation becomes photodissociated. During the cooling of the ammonia, there is likewise photodissociation of the molecules from the upper vibrational level, but there is no two-step process. This stage of photodissociation of non-selectively excited molecules can be avoided by applying the UV radiation in the form of a short pulse. The number of photodissociated ammonia molecules was not measured in the described experiments.

Two-step photodissociation of molecules makes it possible to effect selective photodissociation in a gaseous mixture of molecules whose photodissociation energies practically coincide.

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#### CROSS SECTIONS FOR THE EXCITATION OF Ar II LASER LINES IN ELECTRON-ION COLLISIONS

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An investigation of the lasing mechanism in an argon-ion cw laser [1 - 3] shows that the predominant contribution to the population of the upper laser levels should be made by electronic excitation from the ground state of the ion. To be sure, this conclusion is based on the use of the argon-ion excitation cross sections calculated in the Born-Coulomb approximation for transitions between electronic configurations, and not between the corresponding energy levels of the ion. It is therefore very important to measure in the experiments the argon-ion excitation cross section at low electron energies. Investigations of this kind, however, are extremely difficult. This is evidenced by the experimental papers published to date, in each of which the investigation is limited to the excitation of only one level or one line with the highest probability, namely, the  $\text{He}^+(2s)$  metastable level [4] and the resonance lines of Ba II [5] and Ca II [6].

We have constructed in our laboratory a large-scale mass-spectrometric set-up with intersecting electron and ion beams, for the investigation of excitation of various ionic objects by slow electrons in a wide range of emitted wavelengths. We report here experiments on the excitation of a group of laser lines produced by direct collision of electrons with argon ions in the ground state, i.e., in the process



The argon ions were drawn by an electric field from the source and separated in accord with the  $e/m$  ratio in the mass spectrometer with a non-uniform magnetic field. The ion beam formed by a system of rectangular slits intersected