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The $4p^6$ core excitation of Rb_2 by low energy electron impact

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Synopsis The excitation cross section for unassigned dipole forbidden autoionizing state in Rb_2 molecules was measured in an impact energy range from the excitation threshold at 15.55±0.07 eV up to 17.5 eV. The cross section possesses a resonance shape with the maximum value of $1.0 \pm 0.5 \times 10^{-14}$ cm^2 at 0.4 eV above the excitation threshold.

Alkali dimers are well-known atomic systems for which the energy structure of valence shells is permanently studied both theoretically and experimentally ([1] and references therein). Concerning the sub-valence shells, up to date only for lithium molecules the data on excitation-autoionization process were reported ([2] and references therein).

In the present work, we report the first observation of the $4p^6$-core excitation of Rb_2 molecules in ejected-electron spectra of rubidium vapors excited by low-energy electron impact. The data were obtained by using the ejected-electron spectrometer described earlier [3]. Spectra were recorded at the ejected-electron energy resolution of 0.06 eV. The uncertainties of energy scales were estimated to be ±0.07 eV and ±0.05 eV for incident and ejected electrons, respectively. The obtained relative cross section was put on an absolute scale by normalizing to the cross section of the $(4p^55s^2)^2P_{3/2}$ state obtained earlier for the same impact-energy regime [4].

Figure 1 shows the ejected-electron spectra of rubidium vapors in the region of the $(4p^55s^2)^2P_{3/2}$ lowest atomic autoionizing state at 15.31 eV. The broad line M_x appears close to the $^2P_{3/2}$ line only in spectra at impact energies between 15.5 and 17.5 eV. The measured excitation cross sections for molecular and atomic lines are compared in figure 2. The excitation dynamics of the molecular state points out its dipole forbidden character. A sharp rise of the cross section above 15.7 eV may reflect the presence of the strong negative-ion resonance.

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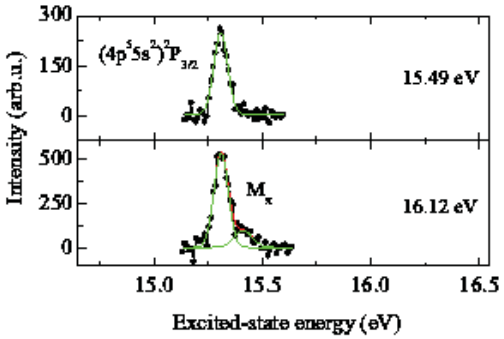

Figure 1. Ejected-electron spectra of rubidium vapors at 15.49 and 16.12 eV impact energy in the region of the $(4p^55s^2)^2P_{3/2}$ state.

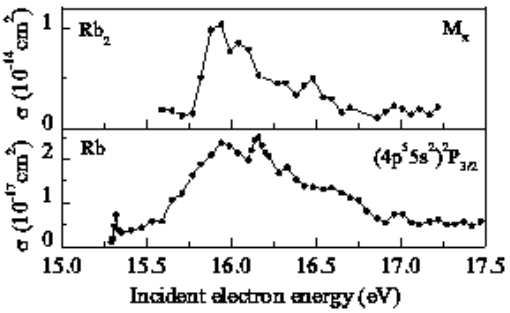

Figure 2. Excitation cross sections of the M_x molecular line and $(4p^55s^2)^2P_{3/2}$ atomic state.

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