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The $2p^6$ autoionization cross section of Na atoms excited by low-energy electron impact

A. Borovik[†][1] **and A. Kupliauskienė**[‡][2]

[†]Department of Electron Processes, Institute of Electron Physics, Uzhgorod, 88017, Ukraine

[‡]Institute of Theoretical Physics and Astronomy, Vilnius University, A.Goštauto 12, LT-01108 Vilnius, Lithuania

Synopsis The $2p^6$ autoionization cross section of Na atoms was measured over the incident electron energy range from the lowest autoionization threshold at 30.77 eV to 37.2 eV. The observed structure was assigned to the negative-ion resonances based upon the lowest autoionizing configurations $2p^5 3s^2$ and $2p^5 3s3p$.

In the present work, we report the $2p^6$ autoionization cross section of sodium atoms obtained as a sum of normalized intensities of lines observed in ejected-electron spectra measured at different impact energies. The spectra were recorded at an observation angle of $54.7°$ using the ejected-electron spectrometer described in detail elsewhere [1]. The experimental conditions were similar to those used earlier for measuring the ejected-electron excitation functions [2]. In particular, the temperature regime of the resistively heated oven ensured a minimum influence of Na_2 molecules on measured spectra.

Figure 1 shows the autoionization cross section (a) derived by the digital processing of the experimental total ionization cross section [3], the present data (b) and the ejected-electron excitation function (c) of the $(2p^5 3s^2)^2P$ state [2] (all normalized to the maximum value). Comparing the data we note good agreement between the data [3] (a) and the present cross section (b) regarding position and relative high of resonance features. The origin of the latter can be seen by comparing to the excitation function of the ^2P state (c). In particular, feature A coincides in shape and position with the strong near-threshold resonance observed in excitation of the ^2P state. In accordance with R-matrix calculations [2], this resonance is a sum of two shape resonances with common configuration $2p^5 3s^2 3p$ formed on the basis of the $(2p^5 3s^2)^2P_{3/2}$ and $^2P_{1/2}$ "parent" states. The stronger feature B is formed by the $2p^5 3s3p^2$ resonance at 33.2 eV observed also in excitation of the ^2P state and, in addition, by a superposition of the near-threshold resonances presented in excitation functions of the autoionizing states
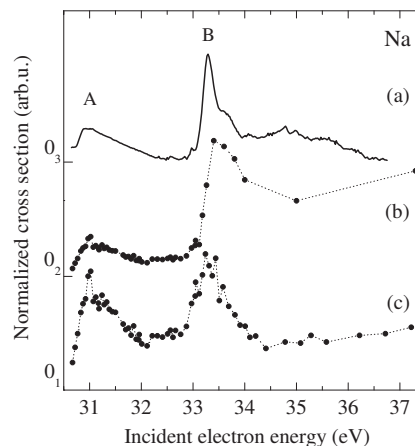
located between 33 and 34 eV.

Figure 1. The autoionization cross section (a) derived from the total ionization cross section of Na atoms [3], present data (b) and the electron impact excitation cross section (c) of the $(2p^5 3s^2)^2P$ state [2].

References

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[1]E-mail: sasha@aborovik.uzhgorod.ua
[2]E-mail: alicija.kupliauskiene@tfai.vu.lt