

Resonant Auger Raman Spectroscopy of the Kr 3p->nl States

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X-ray absorption spectra of the sharp core levels of noble gases (Ne 1s, Ar 2p, Kr 3d, etc.) have been extensively studied and are well understood [1, 2,] but less attention has been given to the broader noble gas core levels [3, 4]. At the Kr 3p edge, the Rydberg states are about 1.4 eV wide, overlap one another and are superimposed on a strong 3d continuum [4]. Thus the peaks are difficult to identify and controversy exists about their assignment [5].

The $3p^{-1}nl$ ($n>4$, $l=0$; $n>3$, $l=2$) Rydberg states decay rapidly via Coster-Kronig (CK) processes to $3d^{-1}4p^{-1}nl$, $3d^{-1}4s^{-1}nl$ and related shake states, and via super Coster-Kronig processes. We have identified the CK states which lie close to the $3d^{-1}4p^{-1}np$ satellite states of the 3d line. On the first main $3p^{-1}nl$ resonance, there is a strong increase in emission below and above the 3d satellites. The peaks have widths determined by the resolution of the photons and the energy analysers, about 200 meV, fulfilling Resonant Auger Raman conditions. The new peaks disperse with photon energy as expected.

Constant Initial State spectra were measured by setting the analysers to energies corresponding to each group of peaks. The CIS spectra show clear differences in the resonant behaviour for different final state. One group of peaks show similar resonant behaviour on the absorption peak that has been attributed to the $3p^{-1}5s$, both for $3p_{3/2}$ and $3p_{1/2}$ at 209.8 and 218 eV photon energy respectively. In contrast two other multiplet groups show completely different resonances, and are assigned to ionic states derived from different intermediate excited states.

By studying the decay states under Resonant Auger Raman conditions and using CIS spectroscopy, we have been able to separate the intermediate states in x-ray absorption at the 3p edge.

[2] O.P. Sairanen et al, Phys. Rev. A **54** (1992) 2834.

[3] T. Kylli et al, Phys. Rev. A. **59** (1999) 4071.

[4] I.T. Steinberger et al, Phys. Rev. B **60** (1999) 3995.

[5] M. Ohno, Phys. Rev. A **51** (1995) 1042.