

Interference Effects between 2p Photoionization and Resonant Auger-Decay Channels at Inner-Shell $2s^{-1}np$ ($n=4,5$) Excitations in Ar

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The 2p shake-up photoelectron spectrum of argon has been widely studied earlier using conventional X-ray sources and more recently using synchrotron radiation. The inherent width of the Ar $2s^{-1}$ state is very large (ca. 2.3 eV), which makes also the analysis of the 2s pre-edge excitations and the following decay processes difficult. Present measurements of the Ar 2p photoelectron satellites and resonant Auger spectra following the 2s pre-edge excitations were performed at the Gas Phase Photoemission beamline of the ELETTRA storage ring in Italy. Utilization of the Auger Resonant Raman effect made it possible to resolve the structures in the decay spectrum.

The decay following the Ar $2s^{-1}np$ ($n = 4, 5$) resonant excitations populate the same final states as the 2p shake-up satellites. Particularly, the $2p^{-1}3p^{-1}np$ states are populated via both the direct and resonant channels. The channels are about the same order of magnitude; therefore interference effects are expected to occur. In the experimental resonant Auger spectrum, both destructive and constructive interference effects can be seen in the $2p^{-1}3p^{-1}4p$ states when compared to the 2p satellite spectrum measured out of the resonance. The experimental results were compared with the predictions of the one-step calculations and they were found to be in good agreement.