

Resonant Auger spectroscopy study of the Al/Al₂O₃ interface

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Introduction

The Auger process has been shown to behave very differently when resonant photon excitation energies are utilized as opposed to energies far above absorption levels [1]. In addition to sublifetime narrowing [2], dramatic modulations in peak intensity can be observed as the excitation photon energy is scanned across the absorption edge [3]. In this study, these properties of resonant Auger spectroscopy are utilized to study the surface of an oxidized Al sample and the interface between the bulk Al and the surface oxidized Al.

Methods and Materials

The sample was prepared by exposing a high-purity Al foil to ambient conditions, which created a passivating aluminum oxide layer approximately 2.5 nm thick. The Auger experiments were performed at the SRI-CAT high-resolution intermediate-energy beamline (2-ID-C) at the Advanced Photon Source. The experiments utilized a Physical Electronics 10-366a hemispherical analyzer. Experiments were performed at constant excitation energy and in a constant final state (CFS) mode. X-ray absorption spectra were also collected for comparison using total electron yield (TEY) mode.

Results and Discussion

Three peaks were observed in the Al-KLL Auger spectrum for the oxidized Al sample as shown in Figure 1. We determined that these three peaks corresponded to the oxidized surface, the nonoxidized bulk, and the oxide-metal interface. As the excitation energy was scanned across the Al-K absorption edge, we observed that these three peaks modulated in intensity differently. When a constant final state spectrum was acquired for each peak in the Auger spectrum, we observed that each valence state of the Al in the sample had a distinct absorption spectrum that could be extracted. These partial yield spectra could then be used to reconstruct the TEY spectrum with a great degree of accuracy. With traditional x-ray absorption measurement, the metal-oxide interface was impossible to observe because the signal from the interface was drowned out by the signal from the rest of the sample. The state-specific absorption measurements taken with resonant Auger spectroscopy allowed for the examination of the x-ray absorption spectrum for each particular region of the sample. This technique allowed for the study of the buried oxide-

metal interface in an entirely nondestructive fashion without resorting to the preparation of a special sample.

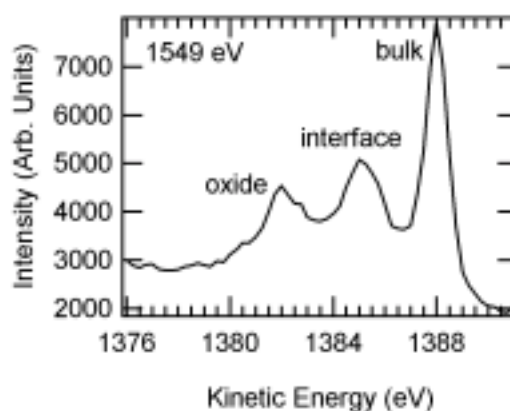


Figure 1: Al-KLL Auger spectrum taken at the Al K absorption edge (1549 eV).

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