BOISE STATE UNIVERSITY
COLLEGE OF ENGINEERING
Micron School of Materials Science and Engineering

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To Whom It May Concern,

Problem Statement:
Client returned a piece of equipment claiming it exhibited unacceptable levels of contamination.

Key Question:
Identify the contaminant and base metal material used for this equipment.

Approach:
Perform photoelectron spectroscopy with sputter depth profiling.

Results:
The piece was loaded into the chamber and an initial scan was acquired in order to identify the contaminant, which is presumed to be a surface coating. The sample surface was then removed by sputtering with argon ions for 30 minutes, which should remove the contaminant layer and expose the base metal material. The acquired data are plotted below.

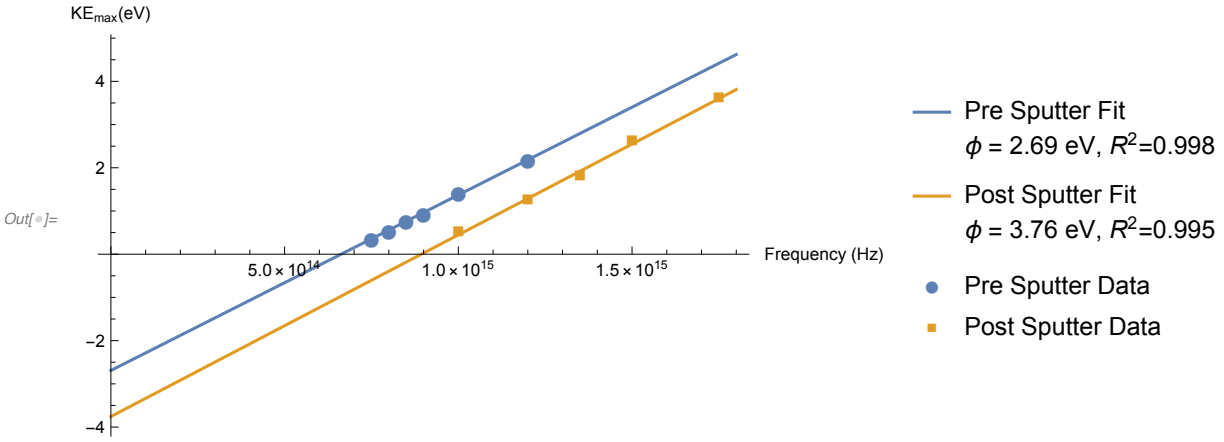

Figure 1. Plot of maximum electron kinetic energy versus incident photo frequency measured from the contaminated part pre and post sputter depth profiling.

Discussion:
The acquired photoelectron data represent the maximum kinetic energy of photo-ejected electrons from the surface of the contaminated piece. According to the photoelectric effect, such data should exhibit a linear trend with a slope equal to Planck's constant and y-axis intercept equal to the material's work function. The key data are summarized in Table 1.

1910 University Drive Boise, Idaho 83725-2090
Phone (208) 426-5600

Table 1. Key Parameters of Photoelectric Spectroscopy.

Sample	Work Function (eV)	Std. Dev. (eV)	Fit Adjusted R Squared
Pre Sputter	2.69	0.07	0.998
Post Sputter	3.8	0.2	0.995

Based on the quality of the linear fits, the data are well described by the photoelectric effect. For the initial piece, the measured work function was 2.69 ± 0.07 eV, which agrees with the known value of 2.75 eV for sodium.[1] Post sputtering, the measured work function was 3.8 ± 0.2 eV, which agrees with the known value for magnesium. It is noted that several pieces of equipment were made for the client using magnesium.

Recommendation:
Baring contamination by the client, it is suspected that pieces were touched with bare hands and/or contaminated gloves after cleaning and prior to packaging. Standard cleaning and packaging protocols for equipment handling will be reviewed. Training records for personnel responsible for equipment cleaning and packaging will be reviewed and updated if certifications have expired.

Report filed by:

Elton Graugnard
Associate Professor
eltongraugnard@boisestate.edu

[1] Source: S.O. Kasap, *Principles of Electronic Materials and Devices*, 4th Ed. (McGraw-Hill 2018), pg. 323