

Li₇P₂S₈Br_{0.5}I_{0.5} (LPSBI) solid state electrolyte by XPS

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ABSTRACT

There have been increasing surface characterization studies of battery materials specifically in the context of before and after cell operation to determine any chemical changes. Therefore, providing reliable reference spectra of battery-related materials is important. In this paper, survey and high-energy resolution data are reported for the solid-state electrolyte Li₇P₂S₈Br_{0.5}I_{0.5}, which has been synthesized and characterized at Pacific Northwest National Laboratory. The current data present narrow-scan regions of I 3d, I 4d, Br 3d, O 1s, P 2p, S 2p, and C 1s core-level spectra, as well as wide-scan survey data that were obtained using the Al K_α x-ray source with a Thermo Fisher Nexsa instrument.

Key words: XPS, LiPSBI, lithium battery, solid electrolyte

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Accession#: 01802, 01803, 01804, and 01805

Technique: XPS

Host Material: Halide-doped sulfide

Instrument: Thermo Fisher Nexsa

Major Elements in Spectra: Li, P, S, Br, I

Minor Elements in Spectra: C

Published Spectra: 13

Spectral Category: Comparison

INTRODUCTION

Due to the increasing global energy demand, alternative energy sources must be explored to replace finite fossil fuel reserves (Ref. 1). One area that is being developed is electric vehicles, which will help decrease CO₂ emissions as well as decrease the dependency on petroleum fuel sources for transportation. Solid-state batteries (SSBs) are one of the promising candidates for next-generation energy storage technology to power electric vehicles given their high energy/power densities and superior safety (Refs. 2–4).

Solid-state electrolytes are crucial to the success of SSBs and should have high ionic conductivity and good chemical/electrochemical stability when in contact with Li metal anodes (Ref. 5). There are few materials that present favorable characteristics in all these categories. Li₇P₂S₈Br_{0.5}I_{0.5} (LPSBI), synthesized and characterized by Lu *et al.* at Pacific Northwest National Laboratory (Ref. 6), is considered a promising candidate due to its high ionic

conductivity of 4.7 mS/cm at room temperature and low areal resistance < 5 Ω cm² in contact with the Li metal. To synthesize LPSBI, stoichiometric amounts of the precursors Li₂S, P₂S₅, LiI, and LiBr were ball milled with a cyclohexane medium followed by heating at 160 °C for 1 h.

X-ray photoelectron spectroscopy (XPS) is an essential tool for battery research (Ref. 7). Therefore, reliable reference spectra as well as careful experimental planning must be employed to ensure quality data and interpretation (Ref. 8). This work provides the XPS data for a novel solid-state electrolyte (LPSBI). The previous characterization of this material has been reported in Ref. 5.

The data presented here were obtained using Al K_α monochromatic x rays for both narrow scan and survey spectra. The narrow scan regions include I 3d, I 4d, Br 3d, O 1s, P 2p, S 2p, and C 1s, which are the major elements observed in the wide-scan survey data.

SPECIMEN DESCRIPTION (ACCESSION # 01802)

Host Material: Halide-doped sulfide

CAS Registry #: Unknown

Host Material Characteristics: Unknown; solid; unknown crystallinity; conductor; inorganic compound; glass ceramic

Chemical Name: Halide-doped sulfide

Source: Pacific Northwest National Laboratory

Host Composition: $\text{Li}_7\text{P}_2\text{S}_8\text{Br}_{0.5}\text{I}_{0.5}$

Form: Powder

Structure: Unknown

History and Significance: $\text{Li}_7\text{P}_2\text{S}_8\text{Br}_{0.5}\text{I}_{0.5}$ was synthesized at Pacific Northwest National Lab in 2019. The powder was synthesized by ball milling followed by heating at 160 °C. The material is highly Li-ion conductive and well known as a solid-state electrolyte for Li batteries. After synthesis, the samples were stored in Ar filled sealed glass vials and then were transferred to a recirculated Ar glove box attached to the XPS transfer arm.

As Received Condition: Powder

Analyzed Region: $400\ \mu\text{m} \times 400\ \mu\text{m}$

Ex Situ Preparation/Mounting: The LPSBI powder was packed into 3 mm diameter and 2 mm deep holes machined into the standard Nexsa powder sample holder made from Cu alloy (phosphor bronze PB102).

In Situ Preparation: None

Charge Control: Dual-beam flood source coupled low-energy ions (0 V, 150 mA) with very low-energy electrons (less than 1 eV) to prevent sample charging during analysis.

Temp. During Analysis: 293 K

Pressure During Analysis: $<2 \times 10^{-7}$ Pa

Pre-analysis Beam Exposure: 0 s

SPECIMEN DESCRIPTION (ACCESSION # 01803)

Host Material: Ag

CAS Registry #: 97161-97-2

Host Material Characteristics: Homogeneous; solid; conductor; metal; other; polycrystalline

Chemical Name: Ag

Source: Alfa Aesar

Host Composition: Ag

Form: 25 mm \times 25 mm \times 1.0 mm thick foil, 99.998% (metal basis)

Structure: Face centered cubic

History and Significance: Premium grade (99.9985%) sample was obtained from Alfa-Aesar

As Received Condition: The Ag foil was received contaminated with hydrocarbons

Analyzed Region: $400\ \mu\text{m} \times 400\ \mu\text{m}$

Ex Situ Preparation/Mounting: The Ag foil was metallurgically polished and ultrasonically cleaned with hexane, acetone, and methyl alcohol before being mounted on the sample holder.

In Situ Preparation: The Ag foil was ion sputtered with 2 KeV Ar^+ ion beam rastered over $2 \times 2\ \text{mm}^2$ area to remove surface contamination.

Charge Control: None

Temp. During Analysis: 293 K

Pressure During Analysis: 6.7×10^{-7} Pa

Pre-analysis Beam Exposure: 0 s

SPECIMEN DESCRIPTION (ACCESSION # 01804)

Host Material: Au

CAS Registry #: 7440-57-5

Host Material Characteristics: Homogeneous; solid; polycrystalline; conductor; metal; other; polycrystalline

Chemical Name: Au

Source: Alfa Aesar

Host Composition: Au

Form: Solid foil

Structure: Face centered cubic

History and Significance: Premium grade (99.9985%) sample was obtained from Alfa-Aesar

As Received Condition: The Au foil was received contaminated with hydrocarbons

Analyzed Region: $400\ \mu\text{m} \times 400\ \mu\text{m}$

Ex Situ Preparation/Mounting: The Au foil was metallurgically polished, ultrasonically cleaned with hexane, acetone, and methyl alcohol before mounted on the sample holder.

In Situ Preparation: The Au foil was ion sputtered with 2 KeV Ar^+ ion beam rastered over $2\ \text{mm} \times 2\ \text{mm}$ area to remove surface contamination.

Charge Control: None

Temp. During Analysis: 293 K

Pressure During Analysis: 6.7×10^{-7} Pa

Pre-analysis Beam Exposure: 0 s

SPECIMEN DESCRIPTION (ACCESSION # 01805)

Host Material: Cu

CAS Registry #: 7440-50-8

Host Material Characteristics: Homogeneous; solid; conductor; metal; other polycrystalline

Chemical Name: Cu

Source: Alfa Aesar

Host Composition: Cu

Form: Solid foil

Structure: Face centered cubic

History and Significance: Premium grade (99.9985%) sample was obtained from Alfa-Aesar

As Received Condition: The Cu foil was received contaminated with hydrocarbons

Analyzed Region: $400\ \mu\text{m} \times 400\ \mu\text{m}$

Ex Situ Preparation/Mounting: The Cu foil was metallurgically polished, ultrasonically cleaned with hexane, acetone, and methyl alcohol before mounted on the sample holder.

In Situ Preparation: The Cu foil was ion sputtered with 2 KeV Ar^+ ion beam rastered over $2 \times 2\ \text{mm}^2$ area to remove surface contamination.

Charge Control: None

Temp. During Analysis: 293 K

Pressure During Analysis: 6.7×10^{-7} Pa

Pre-analysis Beam Exposure: 0 s

INSTRUMENT DESCRIPTION

Manufacturer and Model: Thermo Fisher Nexsa

Analyzer Type: Spherical sector

Detector: Multichannel resistive plate
Number of Detector Elements: 128 Channels

INSTRUMENT PARAMETERS COMMON TO ALL SPECTRA

Spectrometer

Analyzer Mode: Constant pass energy
Throughput ($T = E^N$): $N = 1$
Excitation Source Window: None
Excitation Source: Al K_{α} monochromatic
Source Energy: 1486.68 eV
Source Strength: 72 W
Source Beam Size: 400 $\mu\text{m} \times 400 \mu\text{m}$
Signal Mode: Multichannel direct

Geometry

Incident Angle: 60°
Source-to-Analyzer Angle: 60°
Emission Angle: 0°
Specimen Azimuthal Angle: 0°
Acceptance Angle from Analyzer Axis: 0°
Analyzer Angular Acceptance Width: Nexsa slit is 2 mm wide and 26 mm long (+ – 6 degrees of arc)

Ion Gun

Manufacturer and Model: Thermo Scientific MAGCIS
Energy: 2000 eV
Current: 10 mA
Current Measurement Method: Biased stage
Sputtering Species: Ar⁺
Spot Size (unrastered): 50 μm
Raster Size: 2000 $\mu\text{m} \times 2000 \mu\text{m}$
Incident Angle: 58°
Polar Angle: Beam raster size greater than any angle variation
Azimuthal Angle: 90°
Comment: The ion gun was only used to sputter clean the metal foils used for energy scale calibration

DATA ANALYSIS METHOD

Energy Scale Correction: The sample is conductive and was mounted using a conductive sample holder. These data are reported without any binding energy scale shifts.

Recommended Energy Scale Shift: 0 eV

Peak Shape and Background Method: The Shirley background subtraction algorithm was used for background subtraction (Ref. 9). The full-width-at-half maximum values and peak positions were determined by fitting the peaks in CasaXPS (v.2.3.24) using a Gaussian–Lorentzian peak shape.

Quantitation Method: The atomic concentrations were calculated using the Scofield sensitivity factors in the Thermo Advantage software V 5.9925 build 0670-2 was used for quantification. Normalized Peak Area = Peak Area / (SF * TXFN * ECF); TXFN = transmission function, SF = sensitivity factor, ECF = energy compensation factor. Peak Area [Area (P)], Normalized Area [Area (N)]. The Peak Area is corrected for the total dwell time per channel, number of scans, and energy channel width.

ACKNOWLEDGMENTS

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AUTHOR DECLARATIONS

Conflict of Interest

The authors have no conflicts of interest to disclose.

Author Contributions

Lyndi E. Strange: Formal analysis (equal); Writing – original draft (lead); Writing – review & editing (equal). **Mark H. Engelhard:** Conceptualization (equal); Data curation (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Resources (equal); Supervision (equal); Writing – review & editing (equal). **Zhaoxin Yu:** Project administration (equal). **Dongping Lu:** Funding acquisition (equal).

DATA AVAILABILITY

The data that support the findings of this study are available within the article and its supplementary material.

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SPECTRAL FEATURES TABLE^a

Spectrum ID #	Element/ Transition	Peak Energy (eV)	Peak Width FWHM (eV)	Peak Area (eV × cts/s)	Sensitivity Factor	Concentration (at. %)	Peak Assignment
01802-02	I 3d _{5/2}	619.4	1.4	...	19.87	...	LIPSBI
01802-02	I 3d _{3/2}	630.9	1.4	...	13.77	...	LIPSBI
01802-03	Br 3d _{5/2}	68.7	1.6	...	1.68	...	LIPSBI
01802-03	Br 3d _{3/2}	69.8	1.6	...	1.16	...	LIPSBI
01802-03	I 4d	70.2	3.4	4152.0	...	...	I 4d plasmon 4
01802-03	I 4d	66.4	3.4	5234.3	...	...	I 4d plasmon 3
01802-03	I 4d	63.9	4.1	5470.1	...	...	I 4d plasmon 2
01802-03	I 4d	62.1	2.1	2048.9	...	...	I 4d plasmon 1
01802-03	Br 3d	...	...	28 639.2	2.729	3.0	LIPSBI
01802-03	Li 1s	55.9	1.1	6796.5	0.0568	31.7	LIPSBI
01802-03	I 4d _{5/2}	49.3	1.2	...	...	...	LIPSBI
01802-03	I 4d _{3/2}	51.0	1.2	...	...	...	LIPSBI
01802-03	I 4d	...	...	65 533.2	6.235	3.0	LIPSBI
01802-04	O 1s	531.4	2.1	29 037.52	2.100	3.9	LIPSBI
01802-05	P 2p _{3/2}	132.2	1.0	...	1.192	...	LIPSBI
01802-05	P 2p _{1/2}	133.0	1.0	...	0.789	...	LIPSBI
01802-05	P 2p	132.3	1.5	44 950.1	1.353	9.9	LIPSBI
01802-06	S 2p _{3/2}	161.9	1.0	...	...	...	LIPSBI
01802-06	S 2p _{1/2}	163.0	1.0	...	...	...	LIPSBI
01802-06	S 2p	...	...	2 31 605.2	1.881	37.2	LIPSBI
01802-07	C 1s	284.8	1.5	...	...	...	C–C adventitious carbon
01802-07	C 1s	286.7	1.5	...	...	...	C–O–C adventitious carbon
01802-07	C 1s	289.1	1.5	...	...	...	O–C=O adventitious carbon
01802-07	C 1s	...	...	34 648.1	1.000	11.3	adventitious carbon combined

^aPlasmon peaks associated with the I 3d core level were fit using multiple broad peak components.

ANALYZER CALIBRATION TABLE

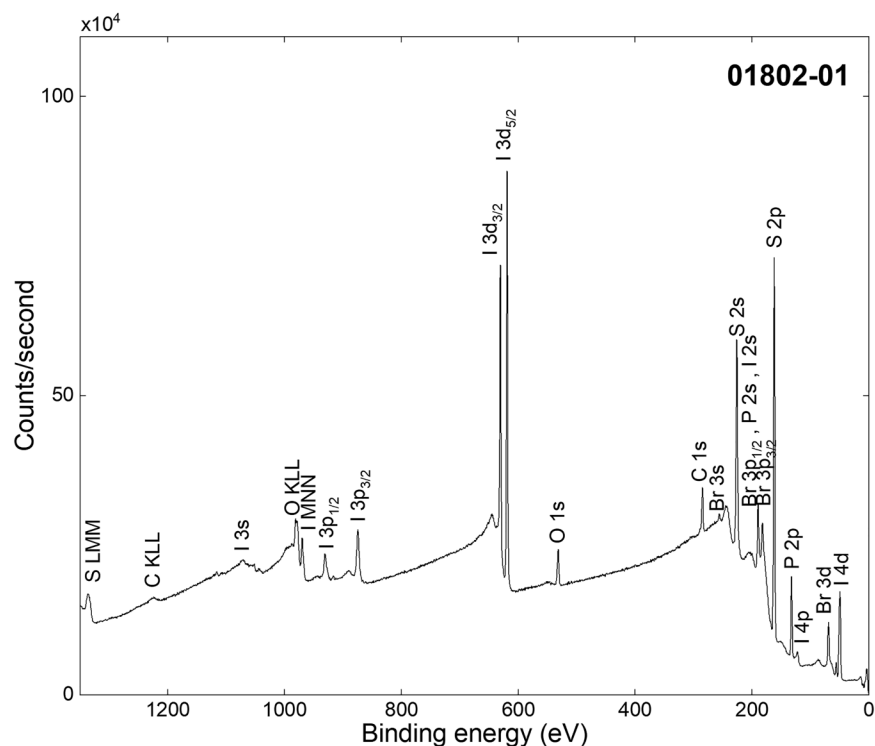
Spectrum ID #	Element/ Transition	Peak Energy (eV)	Peak Width FWHM (eV)	Peak Area (eV × cts/s)	Sensitivity Factor	Concentration (at. %)	Peak Assignment
01803-02	Ag 3d _{5/2}	368.2	0.76	3020944	...	>99	Ag foil
01804-02	Au 4f _{7/2}	84.0	0.98	1949740	...	>99	Au foil
01805-02	Cu 2p _{3/2}	932.6	0.945	3423644	...	>99	Cu foil
01803-02	Ar ⁺ ion sputter cleaned high-purity Ag foil.						
01804-02	Ar ⁺ ion sputter cleaned high-purity Au foil.						
01805-02	Ar ⁺ ion sputter cleaned high-purity Cu foil.						

GUIDE TO FIGURES

Spectrum (Accession) #	Spectral Region	Voltage Shift ^a	Multiplier	Baseline	Comment #
01802-01	LiPSBI survey	0	1	0	1
01802-02	I 3d	0	1	0	1
01802-03	I 4d, Li 1s, Br 3d	0	1	0	1
01802-03	I 4d, Li 1s, Br 3d	0	1	0	1
01802-04	O 1s	0	1	0	1
01802-05	P 2p	0	1	0	1
01802-05	P 2p	0	1	0	1
01802-06	S 2p	0	1	0	1
01802-06	S 2p	0	1	0	1
01802-07	C 1s	0	1	0	1
01802-07	C 1s	0	1	0	1
01803-01	Ag survey	0	1	0	2
01803 -02	Ag 3d	0	1	0	2
01804-01	Au survey	0	1	0	3
01804-02	Au 4f	0	1	0	3
01805-01	Cu survey	0	1	0	4
01805-02	Cu 2p	0	1	0	4

^aVoltage shift of the archived (as-measured) spectrum relative to the printed figure. The figure reflects the recommended energy scale correction due to a calibration correction, sample charging, flood gun, or other phenomenon.

1. Li₇P₂S₈Br_{0.5}I_{0.5} (LPSBI).
2. Ag calibration.
3. Au calibration.
4. Cu calibration.



01802-01

Accession #:

01802-01

Host Material:

Halide-doped sulfide

Technique:

XPS

Spectral Region:

Survey

Instrument:

Thermo Fisher Nexsa

Excitation Source:

Al K_{α} monochromatic

Source Energy:

1486.68 eV

Source Strength:

72 W

Source Size:

0.40 mm \times 0.40 mm

Analyzer Type:

Spherical sector analyzer

Incident Angle:

60°

Emission Angle:

55°

Analyzer Pass Energy:

200 eV

Analyzer Resolution:

0.5 eV

Total Signal Accumulation Time:

4640 s

Total Elapsed Time:

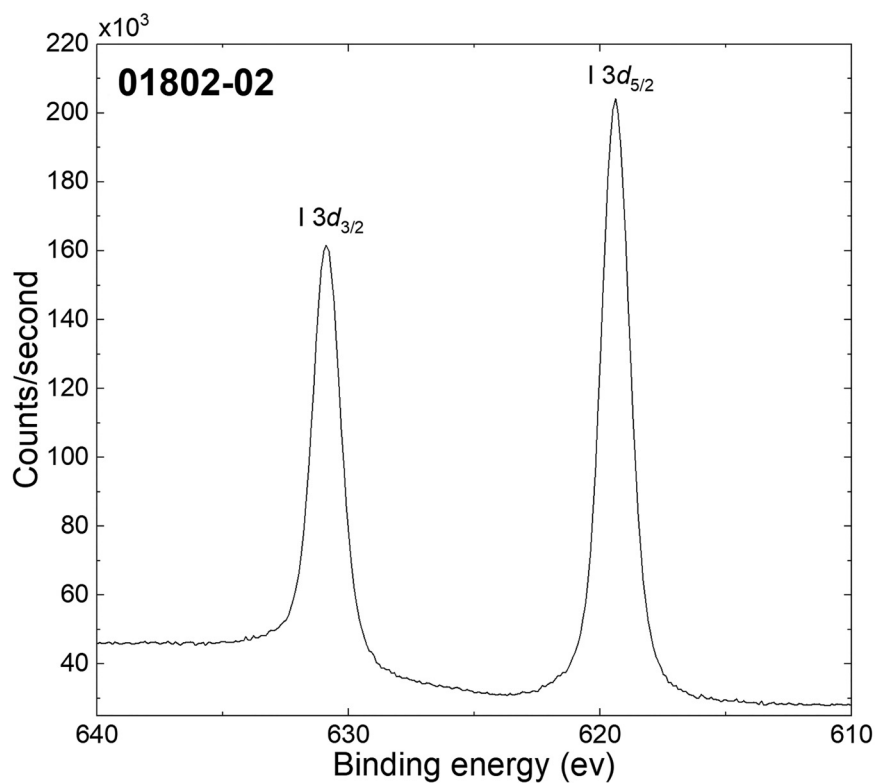
4640 s

Number of Scans:

8

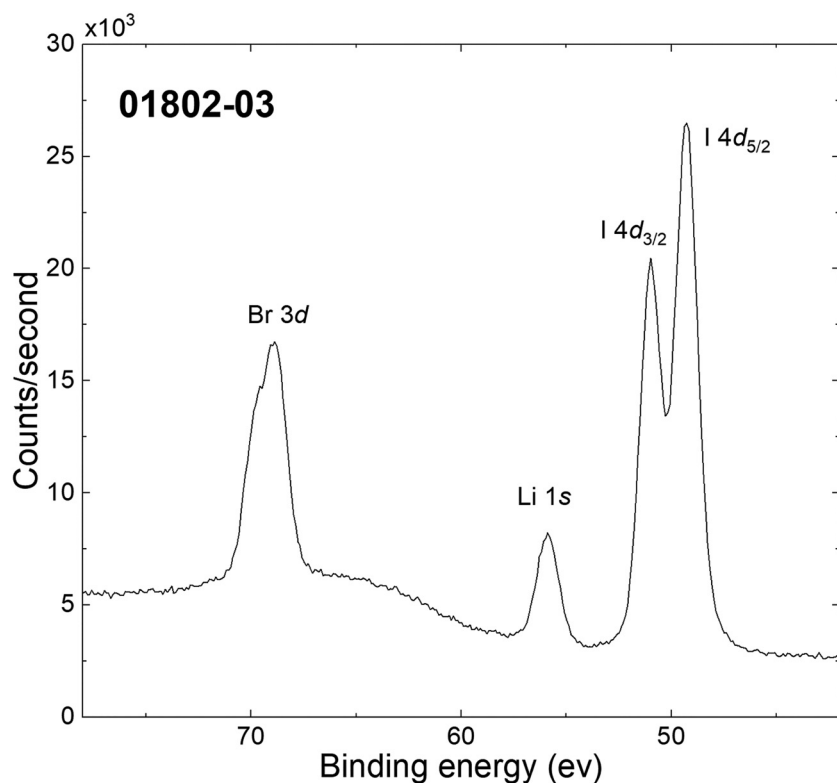
Effective Detector Width:

0.5 eV



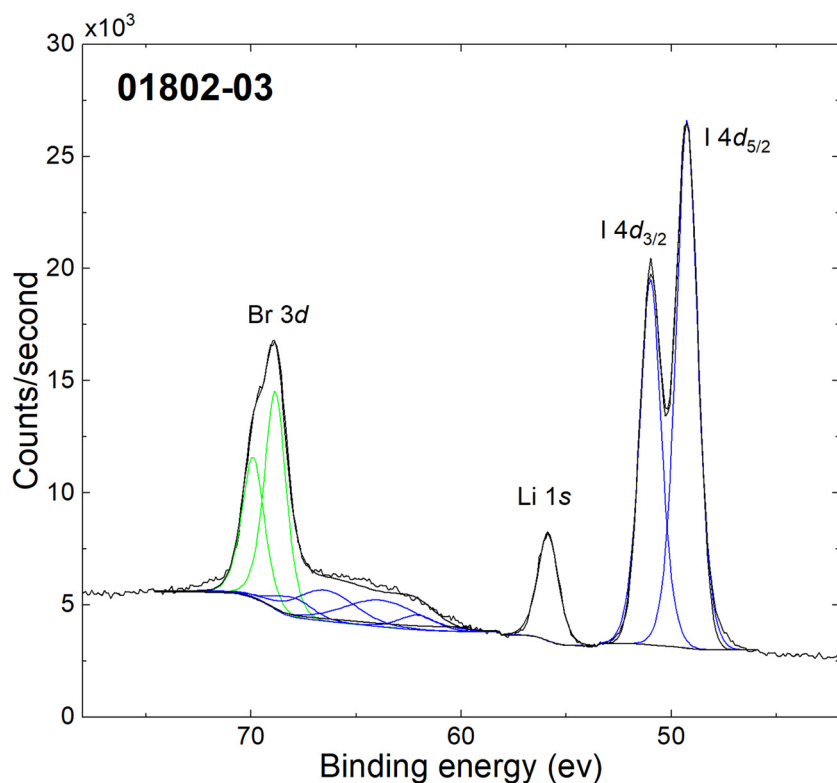
- Accession #: 01802-02
- Host Material: Halide-doped sulfide
- Technique: XPS
- Spectral Region: I 3d

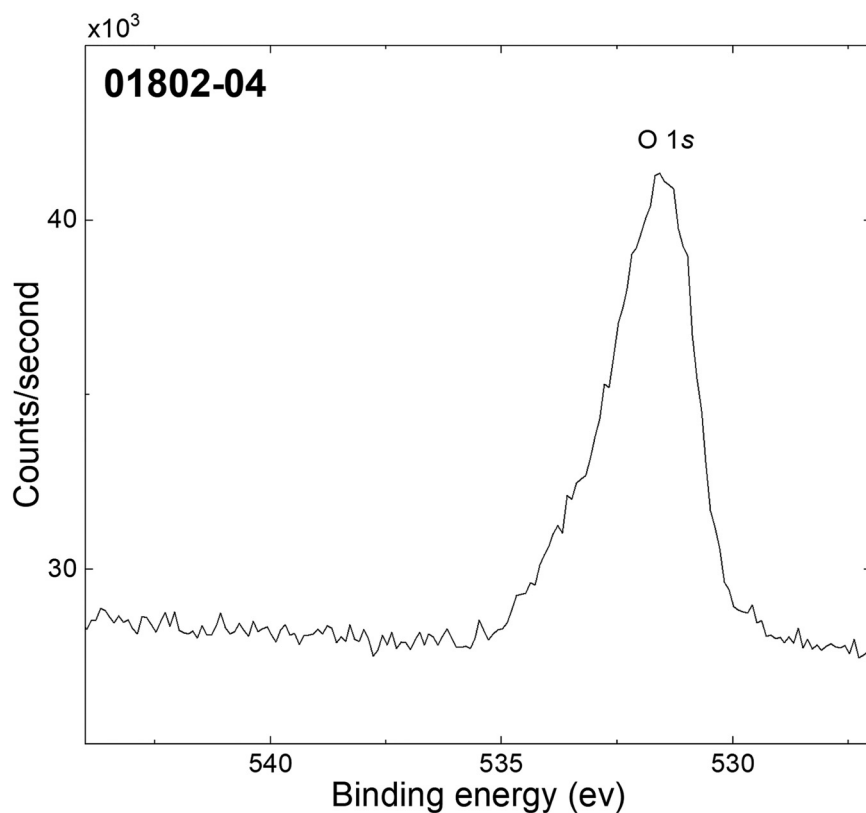
Instrument: Thermo Fisher Nexsa
 Excitation Source: Al K_{α} monochromatic
 Source Energy: 1486.68 eV
 Source Strength: 72 W
 Source Size: 0.40 mm \times 0.40 mm
 Analyzer Type: Spherical sector
 Incident Angle: 60°
 Emission Angle: 0°
 Analyzer Pass Energy 50 eV
 Analyzer Resolution: 0.5 eV
 Total Signal Accumulation Time: 1059.2 s
 Total Elapsed Time: 1268.0 s
 Number of Scans: 8
 Effective Detector Width: 0.1 eV



- Accession #: 01802-03
- Host Material: Halide-doped sulfide
- Technique: XPS
- Spectral Region: I 4d, Li 1s, Br 3d

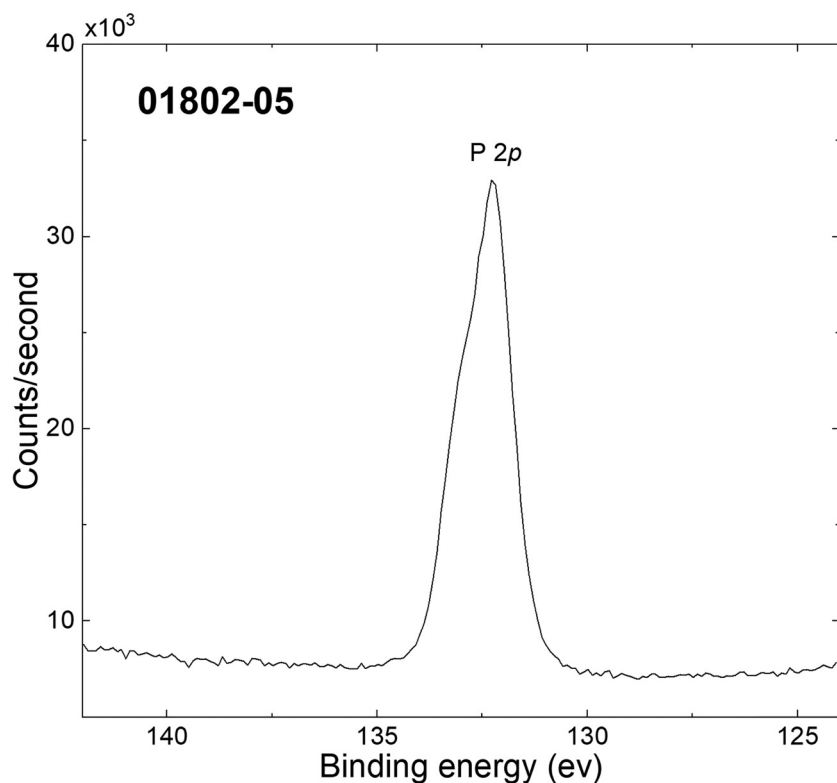
Instrument: Thermo Fisher Nexsa
 Excitation Source: Al K_α monochromatic
 Source Energy: 1486.68 eV
 Source Strength: 72 W
 Source Size: 0.40 mm × 0.40 mm
 Analyzer Type: Spherical sector
 Incident Angle: 60°
 Emission Angle: 0°
 Analyzer Pass Energy 50 eV
 Analyzer Resolution: 0.5 eV
 Total Signal Accumulation Time: 252.7 s
 Total Elapsed Time: 1421.0 s
 Number of Scans: 14
 Effective Detector Width: 0.1 eV





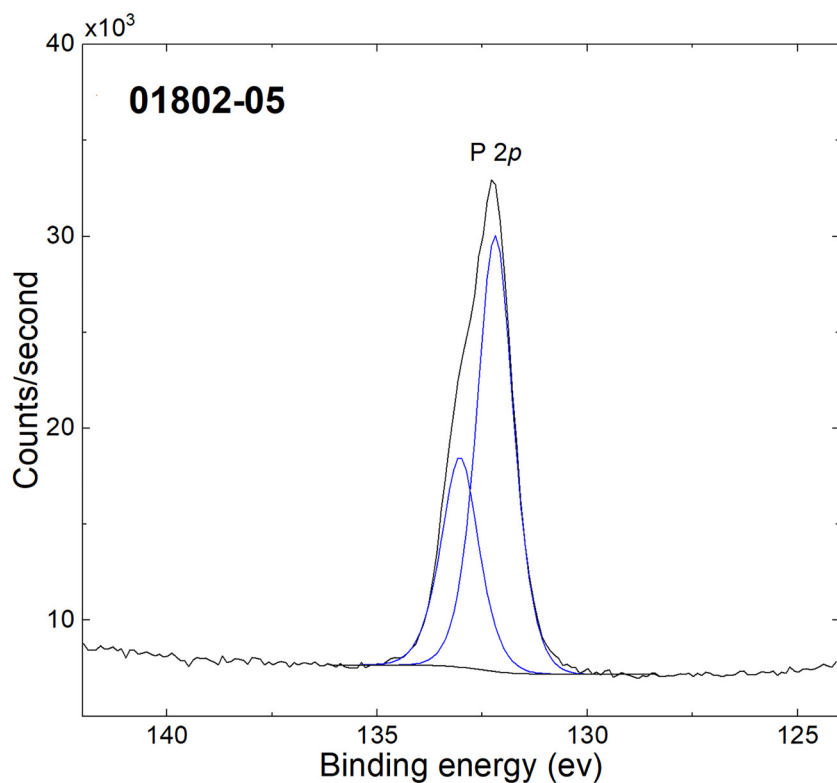
- Accession #: [01802-04](#)
- Host Material: Halide-doped sulfide
- Technique: XPS
- Spectral Region: O 1s

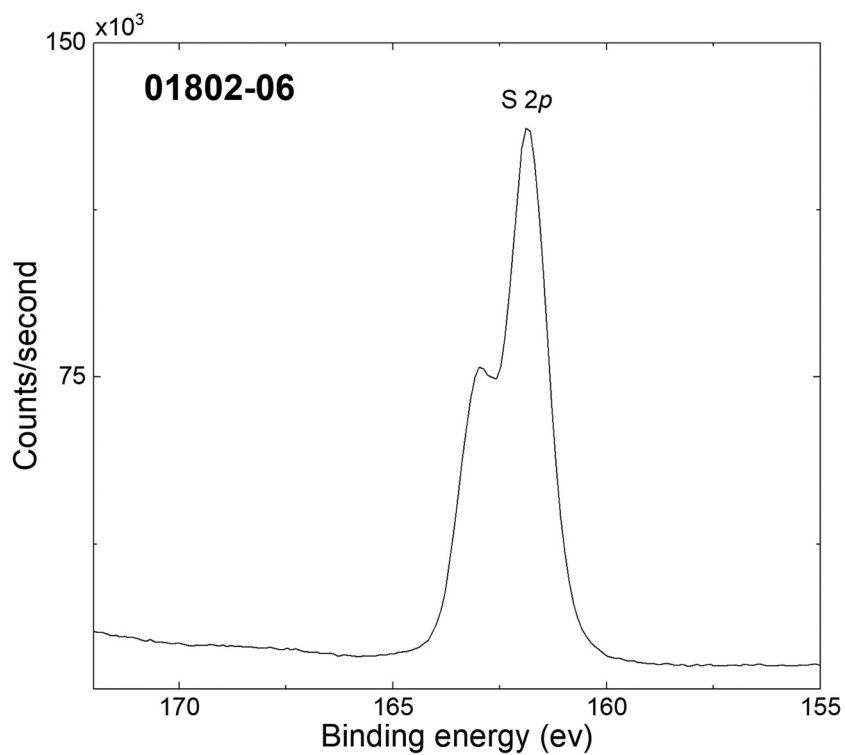
Instrument: Thermo Fisher Nexsa
 Excitation Source: Al K_{α} monochromatic
 Source Energy: 1486.68 eV
 Source Strength: 72 W
 Source Size: 0.40 mm \times 0.40 mm
 Analyzer Type: Spherical sector
 Incident Angle: 60°
 Emission Angle: 0°
 Analyzer Pass Energy 50 eV
 Analyzer Resolution: 0.5 eV
 Total Signal Accumulation Time: 905 s
 Total Elapsed Time: 1232.0 s
 Number of Scans: 10
 Effective Detector Width: 0.1 eV



- Accession #: [01802-05](#)
- Host Material: Halide-doped sulfide
- Technique: XPS
- Spectral Region: P 2p

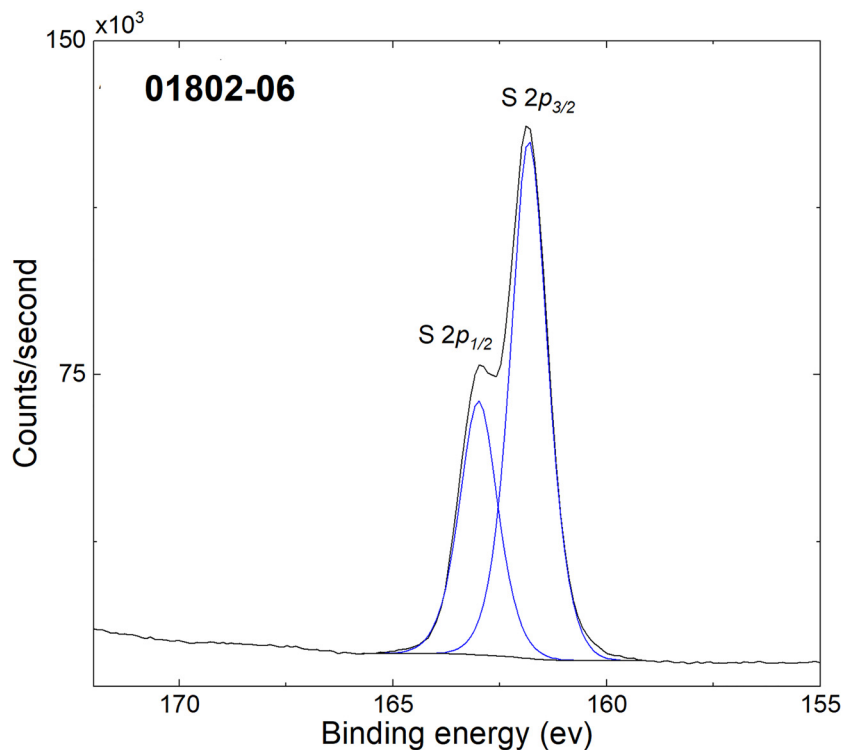
Instrument: Thermo Fisher Nexsa
 Excitation Source: Al K_{α} monochromatic
 Source Energy: 1486.68 eV
 Source Strength: 72 W
 Source Size: 0.40 mm \times 0.40 mm
 Analyzer Type: Spherical sector
 Incident Angle: 60°
 Emission Angle: 0°
 Analyzer Pass Energy 50 eV
 Analyzer Resolution: 0.5 eV
 Total Signal Accumulation Time: 905 s
 Total Elapsed Time: 1231 s
 Number of Scans: 10
 Effective Detector Width: 0.1 eV

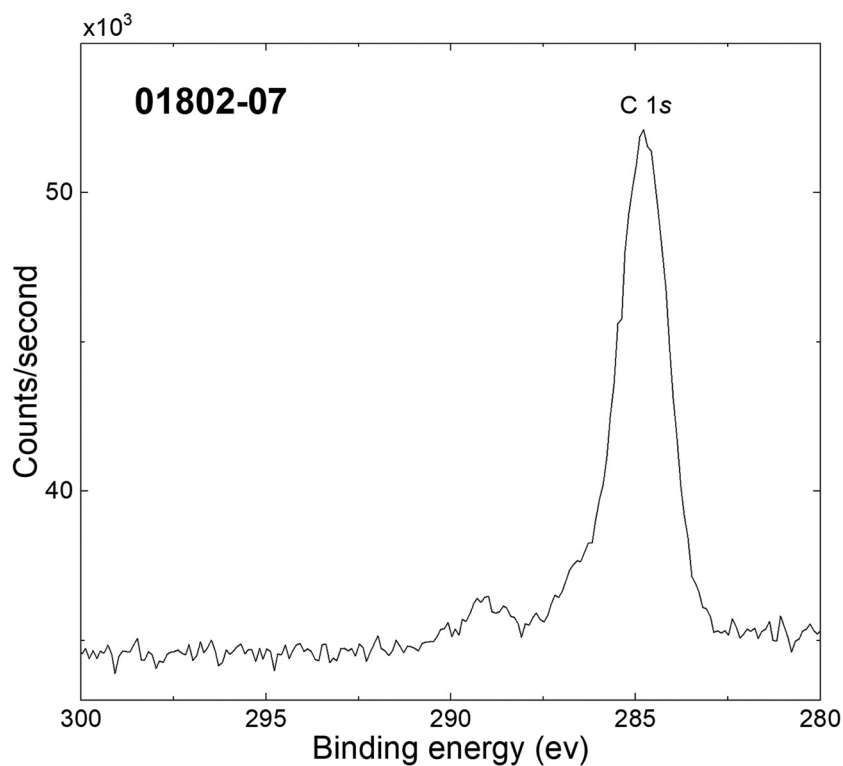




■ Accession #: [01802-06](#)
 ■ Host Material: Halide-doped sulfide
 ■ Technique: XPS
 ■ Spectral Region: S 2p

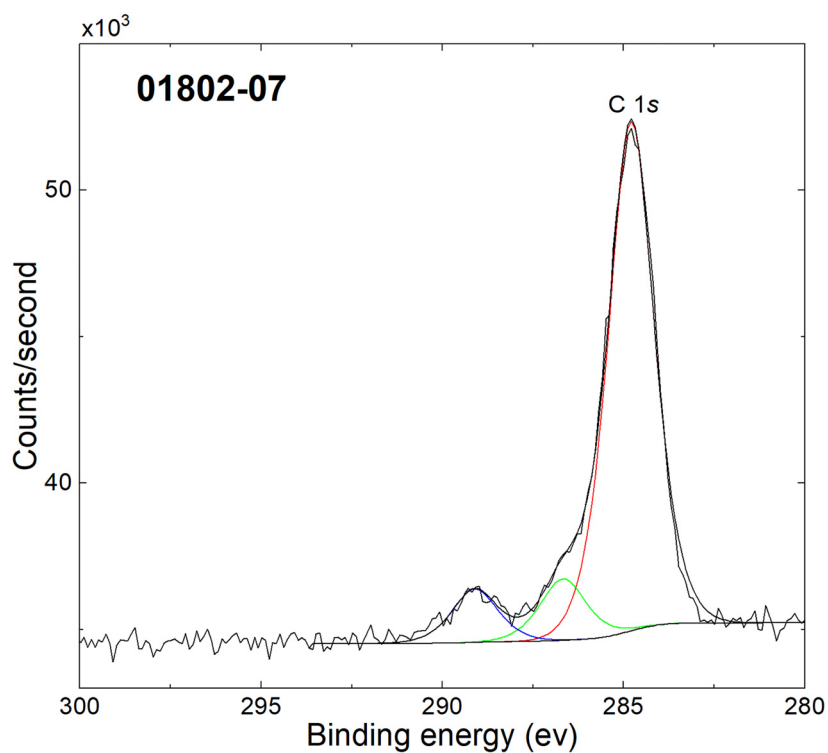
Instrument: Thermo Fisher Nexsa
 Excitation Source: Al K_{α} monochromatic
 Source Energy: 1486.68 eV
 Source Strength: 72 W
 Source Size: 0.40 mm \times 0.40 mm
 Analyzer Type: Spherical sector
 Incident Angle: 60°
 Emission Angle: 0°
 Analyzer Pass Energy 50 eV
 Analyzer Resolution: 0.5 eV
 Total Signal Accumulation Time: 1100 s
 Total Elapsed Time: 1252 s
 Number of Scans: 10
 Effective Detector Width: 0.1 eV

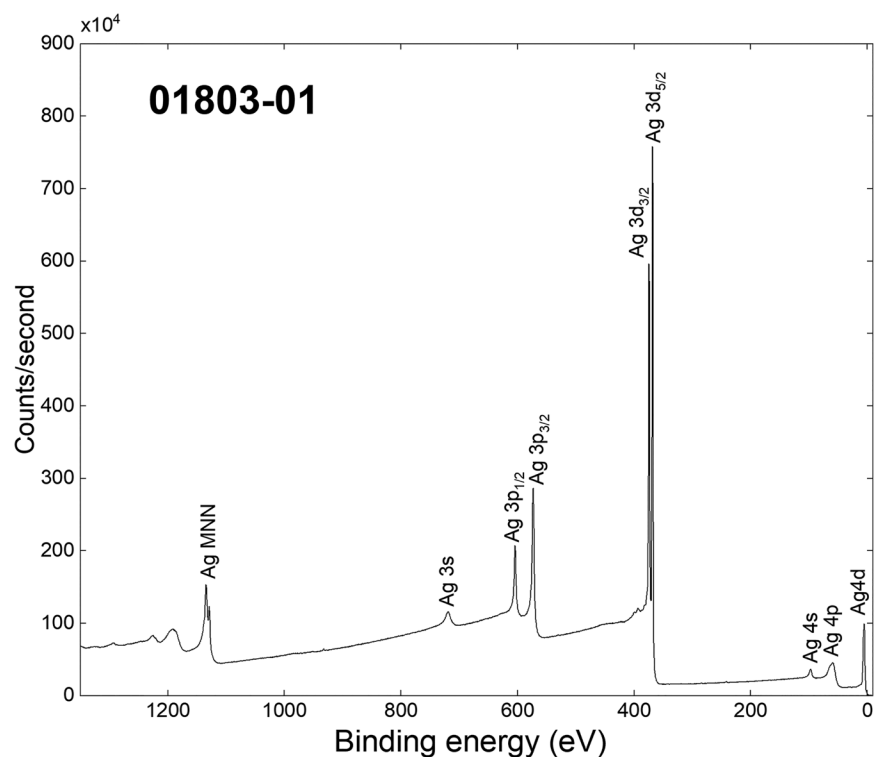




- Accession #: 01802-07
- Host Material: Halide-doped sulfide
- Technique: XPS
- Spectral Region: C 1s

Instrument: Thermo Fisher Nexs
 Excitation Source: Al K_{α} monochromatic
 Source Energy: 1486.68 eV
 Source Strength: 72 W
 Source Size: 0.40 mm \times 0.40 mm
 Analyzer Type: Spherical sector
 Incident Angle: 60°
 Emission Angle: 0°
 Analyzer Pass Energy 50 eV
 Analyzer Resolution: 0.5 eV
 Total Signal Accumulation Time: 1150.0 s
 Total Elapsed Time: 1208 s
 Number of Scans: 10
 Effective Detector Width: 0.1 eV

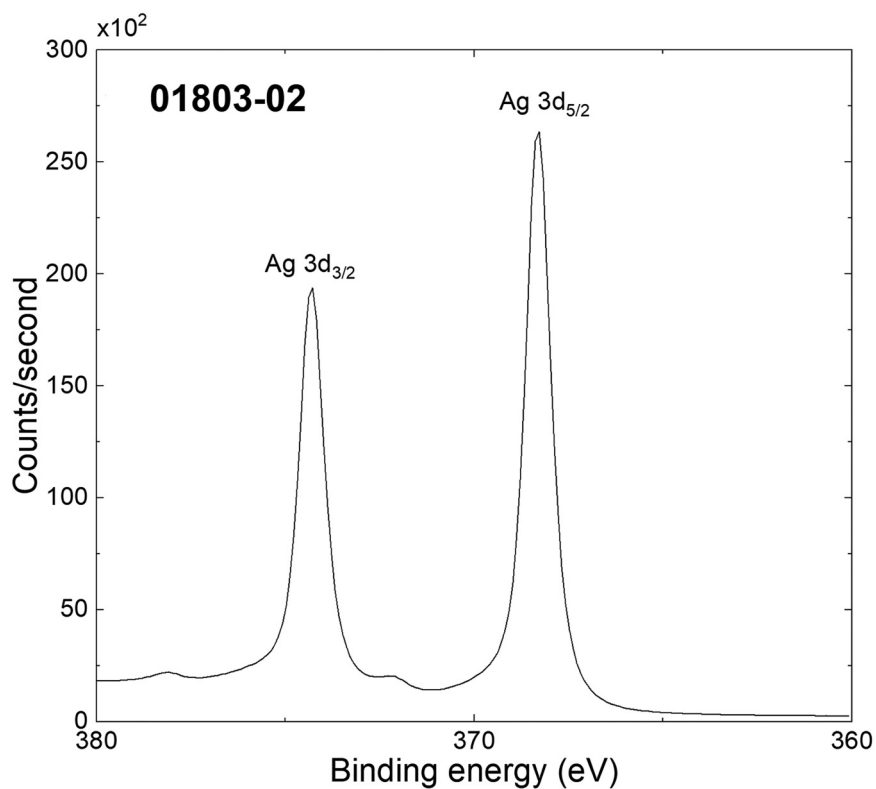




Accession #:

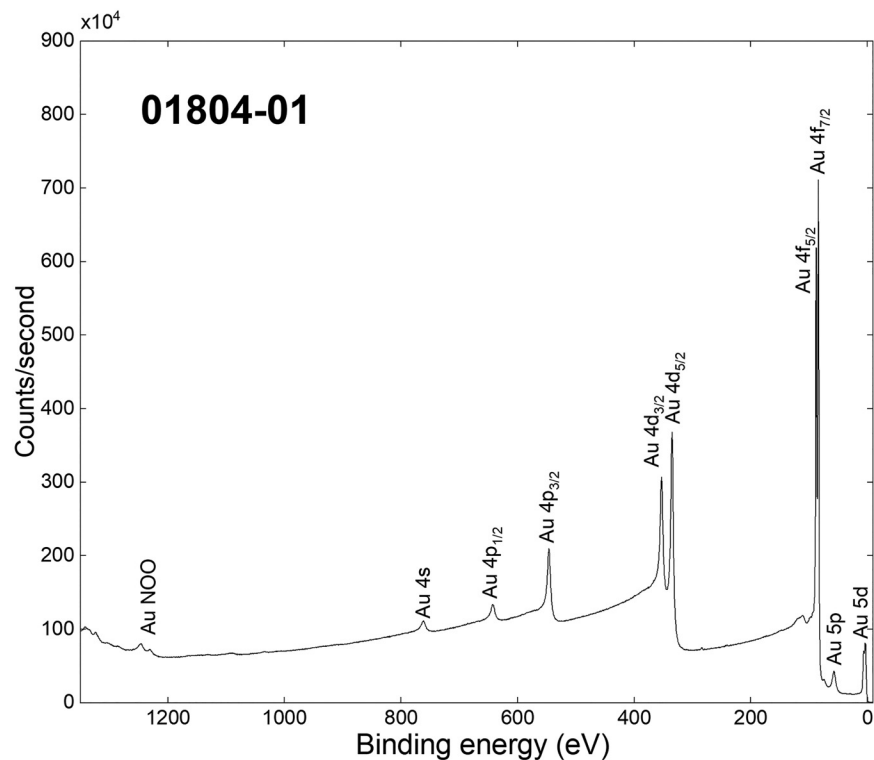
01803-01

■ Host Material:	Ag
■ Technique:	XPS
■ Spectral Region:	Survey
Instrument:	Thermo Fisher Nexsa
Excitation Source:	Al K_{α} monochromatic
Source Energy:	1486.68 eV
Source Strength:	72 W
Source Size:	0.30 mm × 0.30 mm
Analyzer Type:	Spherical sector analyzer
Incident Angle:	60°
Emission Angle:	0°
Analyzer Pass Energy:	200 eV
Analyzer Resolution:	0.5 eV
Total Signal Accumulation Time:	325.52 s
Total Elapsed Time:	325.52 s
Number of Scans:	6
Effective Detector Width:	0.5 eV



- Accession #: 01803-02
- Host Material: Ag
- Technique: XPS
- Spectral Region: Ag 3d

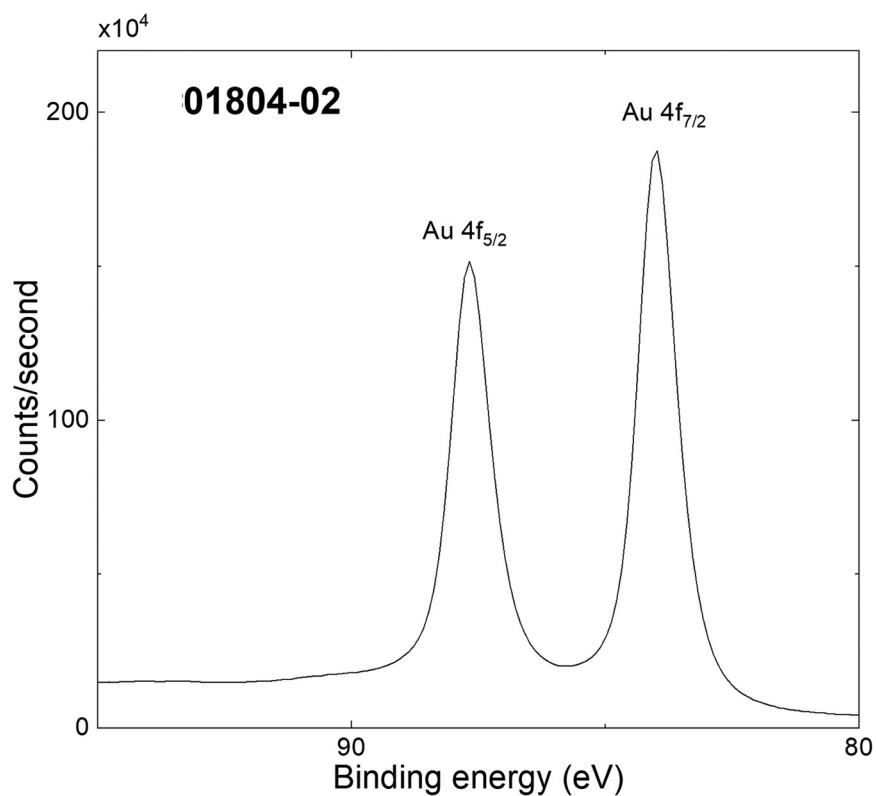
Instrument: Thermo Fisher Nexsa
 Excitation Source: Al K_α monochromatic
 Source Energy: 1486.68 eV
 Source Strength: 72 W
 Source Size: 0.30 mm × 0.30 mm
 Analyzer Type: Spherical sector
 Incident Angle: 60°
 Emission Angle: 0°
 Analyzer Pass Energy 50 eV
 Analyzer Resolution: 0.5 eV
 Total Signal Accumulation Time: 2160 s
 Total Elapsed Time: 2160 s
 Number of Scans: 12
 Effective Detector Width: 0.1 eV



Accession #:

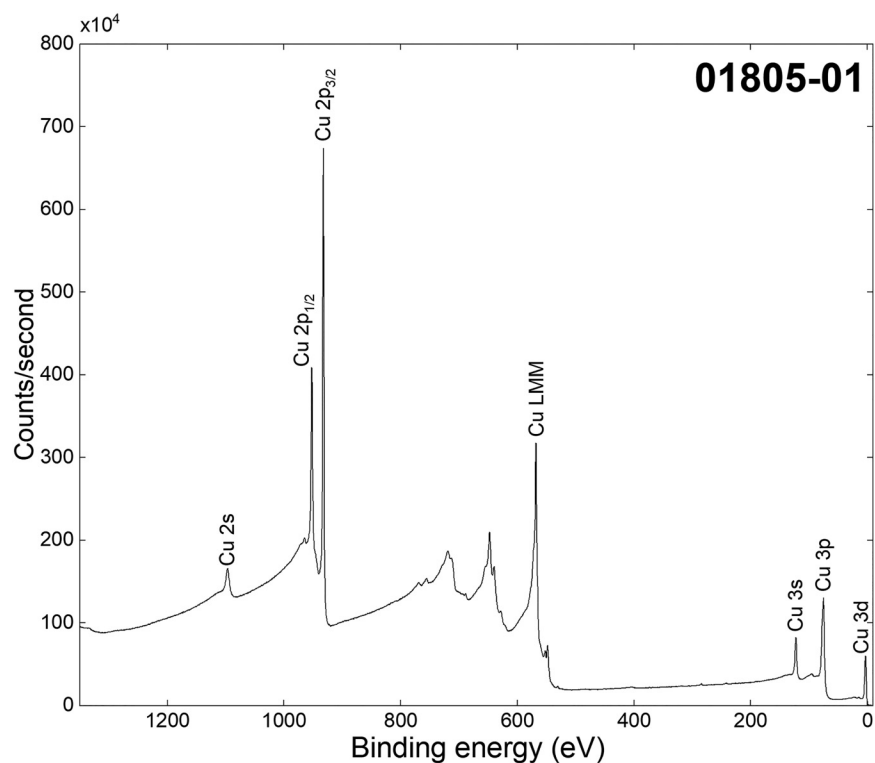
01804-01

■ Host Material:	Au
■ Technique:	XPS
■ Spectral Region:	Survey
Instrument:	Thermo Fisher Nexsa
Excitation Source:	Al K _α monochromatic
Source Energy:	1486.68 eV
Source Strength:	72 W
Source Size:	0.30 mm × 0.30 mm
Analyzer Type:	Spherical sector analyzer
Incident Angle:	60°
Emission Angle:	0°
Analyzer Pass Energy:	200 eV
Analyzer Resolution:	0.5 eV
Total Signal Accumulation Time:	325.52 s
Total Elapsed Time:	325.52 s
Number of Scans:	6
Effective Detector Width:	0.5 eV



- Accession #: [01804-02](#)
- Host Material: Au
- Technique: XPS
- Spectral Region: Au 4f

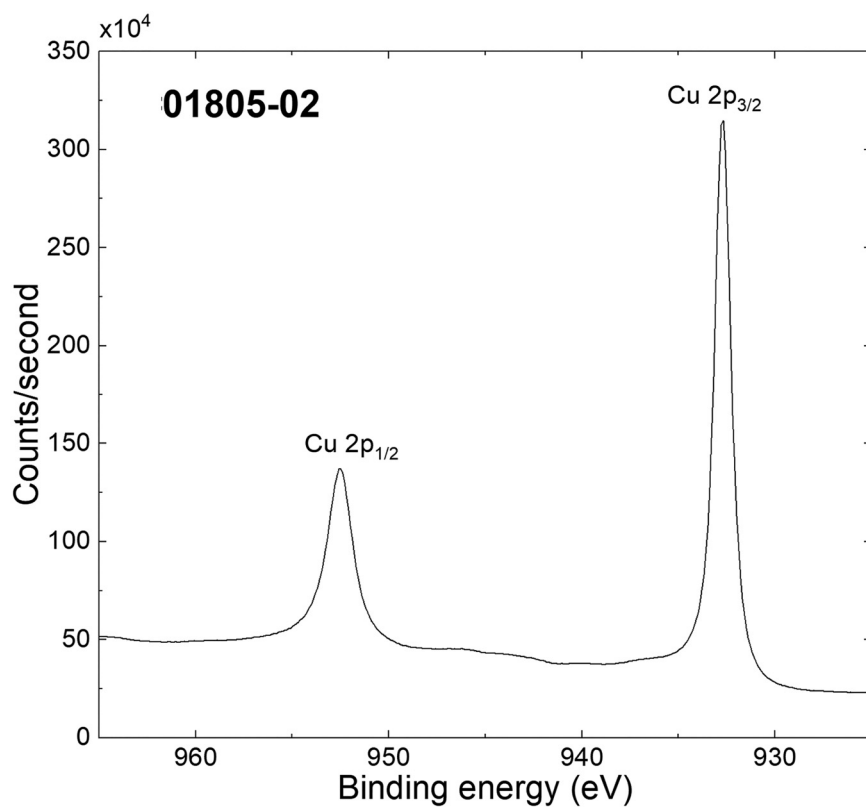
Instrument: Thermo Fisher Nexsa
 Excitation Source: Al K_α monochromatic
 Source Energy: 1486.68 eV
 Source Strength: 72 W
 Source Size: 0.30 mm × 0.30 mm
 Analyzer Type: Spherical sector
 Incident Angle: 60°
 Emission Angle: 0°
 Analyzer Pass Energy 50 eV
 Analyzer Resolution: 0.5 eV
 Total Signal Accumulation Time: 1185 s
 Total Elapsed Time: 1440 s
 Number of Scans: 12
 Effective Detector Width: 0.1 eV



Accession #:

01805-01

■ Host Material:	Cu
■ Technique:	XPS
■ Spectral Region:	Survey
Instrument:	Thermo Fisher Nexsa
Excitation Source:	Al K _α monochromatic
Source Energy:	1486.68 eV
Source Strength:	72 W
Source Size:	0.30 mm × 0.30 mm
Analyzer Type:	Spherical sector analyzer
Incident Angle:	60°
Emission Angle:	0°
Analyzer Pass Energy:	200 eV
Analyzer Resolution:	0.5 eV
Total Signal Accumulation Time:	325.52 s
Total Elapsed Time:	325.52 s
Number of Scans:	6
Effective Detector Width:	0.5 eV



■ Accession #: [01805-02](#)
 ■ Host Material: Cu
 ■ Technique: XPS
 ■ Spectral Region: Cu 2p

Instrument: Thermo Fisher Nexsa
 Excitation Source: Al K_α monochromatic
 Source Energy: 1486.68 eV
 Source Strength: 72 W
 Source Size: 0.30 mm × 0.30 mm
 Analyzer Type: Spherical sector
 Incident Angle: 60°
 Emission Angle: 0°
 Analyzer Pass Energy 50 eV
 Analyzer Resolution: 0.5 eV
 Total Signal Accumulation Time: 1440 s
 Total Elapsed Time: 1440 s
 Number of Scans: 12
 Effective Detector Width: 0.1 eV