

# Polystyrene by XPS

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X-ray photoelectron spectroscopy was used to analyze a thin film of polystyrene. Spin casting from a 2% by weight solution of polystyrene in toluene was utilized. Film thickness was determined to be 60 nm by ellipsometry. The thin film was examined with a Hewlett Packard 5950A ESCA spectrometer.

**Keywords:** polymer; polystyrene; XPS; valence band

**PACS:** 79.60.Fr, 82.80.Pv, 71.20.Hk

Accession #: 00078

Technique: XPS

Host Material: polystyrene

Instrument: Hewlett Packard 5950A

Major Elements in Spectrum: C

Minor Elements in Spectrum: none

Printed Spectra: 3

Spectra in Electronic Record: 4

Spectral Category: comparison

## SPECIMEN DESCRIPTION

**Host Material:** polystyrene

**CAS Registry #:** 9003-53-6

**Host Material Characteristics:** homogeneous; solid; amorphous; dielectric; polymer; thin film

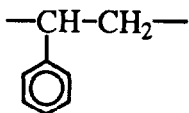
**Chemical Name:** not specified

**Source:** Scientific Polymer Products

**Host Composition:** carbon

**Form:** thin film

**Structure:**



**As Received Condition:** The sample was received as pellets.

**Analyzed Region:** host material

**Ex Situ Preparation/Mounting:** The sample was spin cast onto a gold substrate from a 2% weight solution of polystyrene in toluene.

**In Situ Preparation:** none

**Charge Control:** A Hewlett Packard 18623A flood gun was used at an electron energy of 0.25 eV and a current of 0.1 mA.

**Temp. During Analysis:** 300 K

**Pressure During Analysis:**  $< 1.06 \times 10^{-6}$  Pa

## SPECTROMETER DESCRIPTION

**Manufacturer and Model:** Hewlett Packard 5950A

**Analyzer Type:** spherical sector

**Detector:** multichannel resistive plate

## INSTRUMENT PARAMETERS COMMON TO ALL SPECTRA

### Spectrometer

**Analyzer Mode:** constant pass energy

**Throughput ( $T=E^N$ ):**  $N = -0.5$

**Excitation Source:** Al  $K_{\alpha}$  monochromatic

**Excitation Source Window:** Al foil

**Source Energy:** 1486.6

**Source Strength:** 800 W

**Source Beam Size:** 1 mm  $\times$  5 mm

**Signal Mode:** multichannel direct

**Simultaneous Channels:** 256

### Geometry

**Incident Angle:** 26°

**Source to Analyzer Angle:** 78°

**Emission Angle:** 52°

**Specimen Azimuthal Angle:** 180°

**Acceptance Angle from Analyzer Axis:** 0°

## DATA ANALYSIS METHOD

**Energy Scale Correction:** The C 1s peak was referenced to 284.0 eV.

## ACKNOWLEDGMENTS

We are grateful to the IBM Thomas J. Watson Research Center for the generous gift of the HP 5950A spectrometer.

**REFERENCES**

1. E. Orti, J. L. Bredas, J. J. Pireaux, and N. Ishihara, J. Electron. Spectrosc. Relat. Phenom. **52**, 551 (1990).

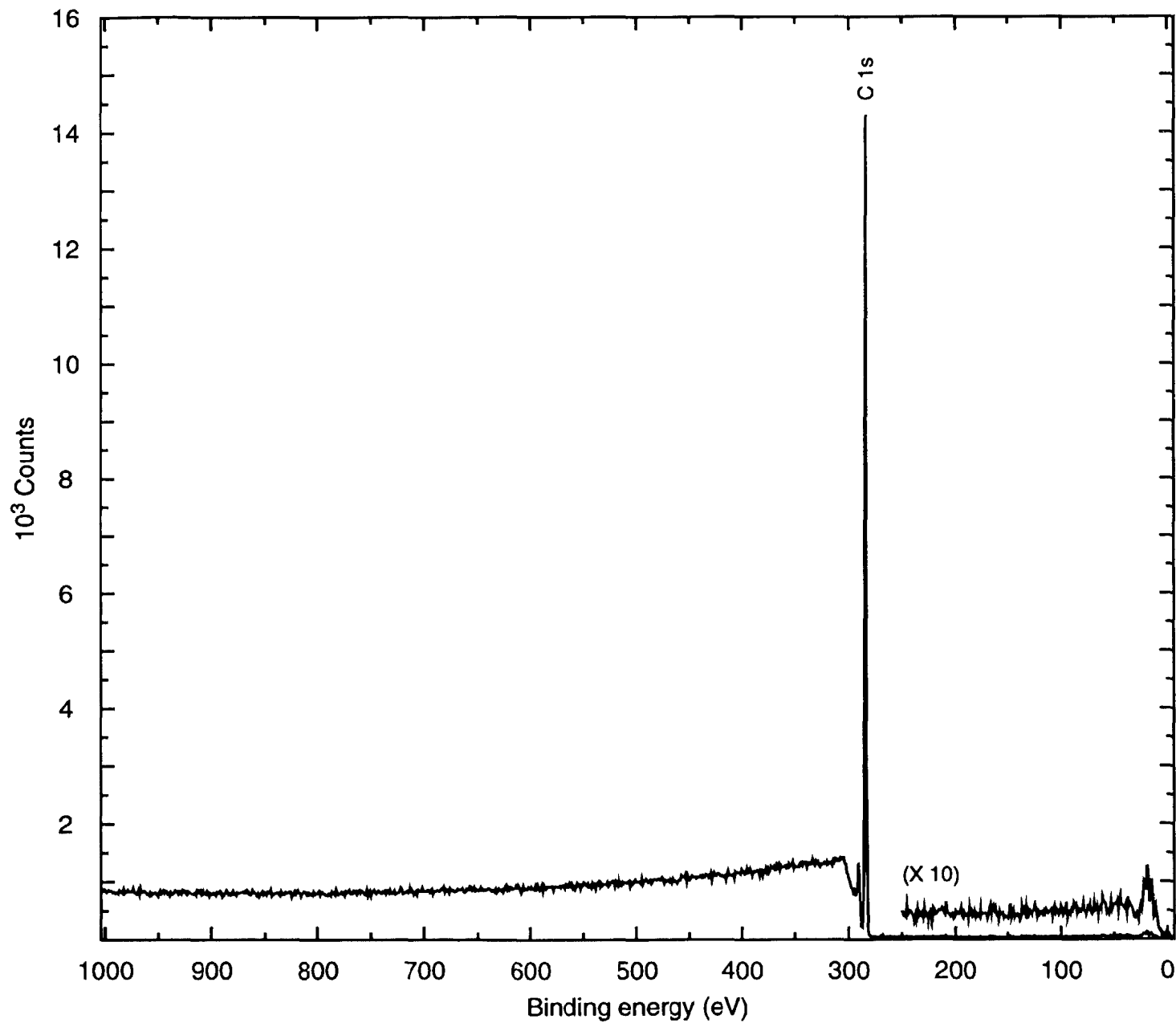
**SPECTRAL FEATURES TABLE**

Spectrum ID #	Element/Transition	Peak Energy (eV)	Peak Width FWHM (eV)	Peak Height (counts)	Sensitivity Factor	Concentration (at. %)	Peak Assignment
1	C 1s	284.0	1.2	14311	1.0	...	...
2	C 1s	284.0	1.2	19900	1.0	...	...
2	C 1s	290.6	2.5	1660	...	...	shake-up $\pi \rightarrow \pi^*$

**ANALYZER CALIBRATION TABLE**

Spectrum ID #	Element/Transition	Peak Energy (eV)	Peak Width FWHM (eV)	Peak Height (counts)	Sensitivity Factor	Concentration (at. %)	Peak Assignment
4 <sup>a</sup>	Au 4f	87.8	0.9	6170	7.54	...	...
4 <sup>a</sup>	Au 4f	84.1	1.1	7215	9.58	...	...

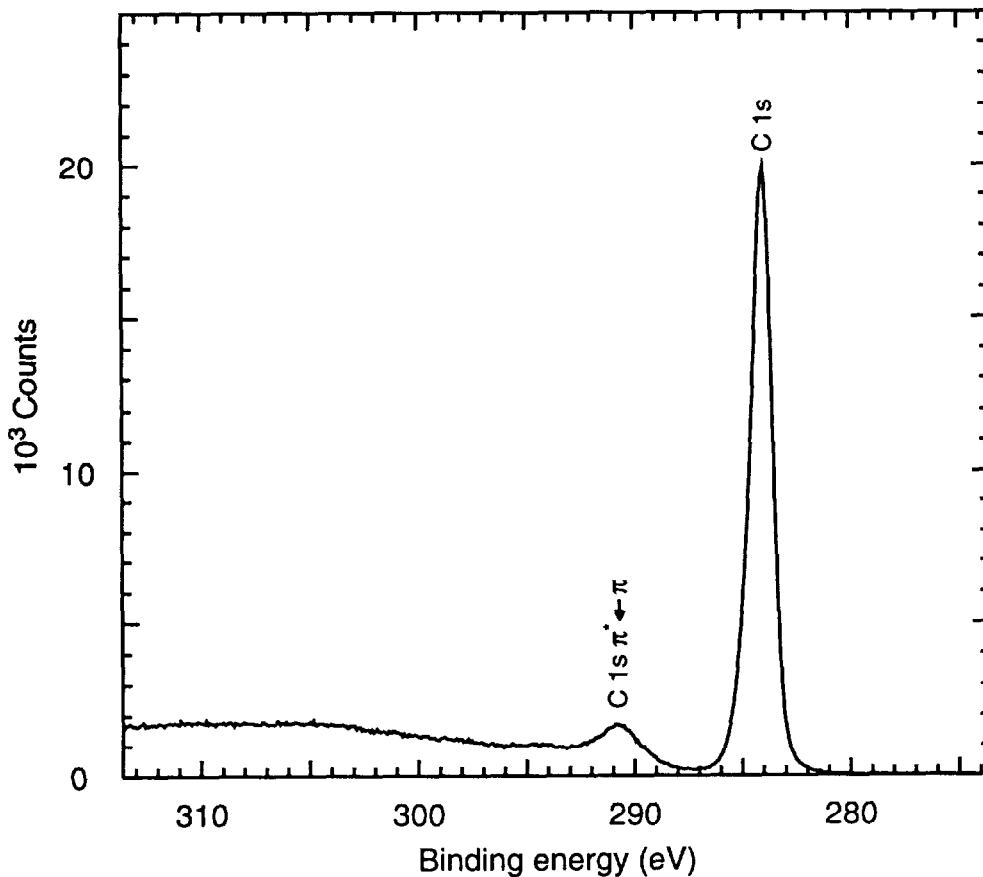
<sup>a</sup>Gold coated copper substrate.



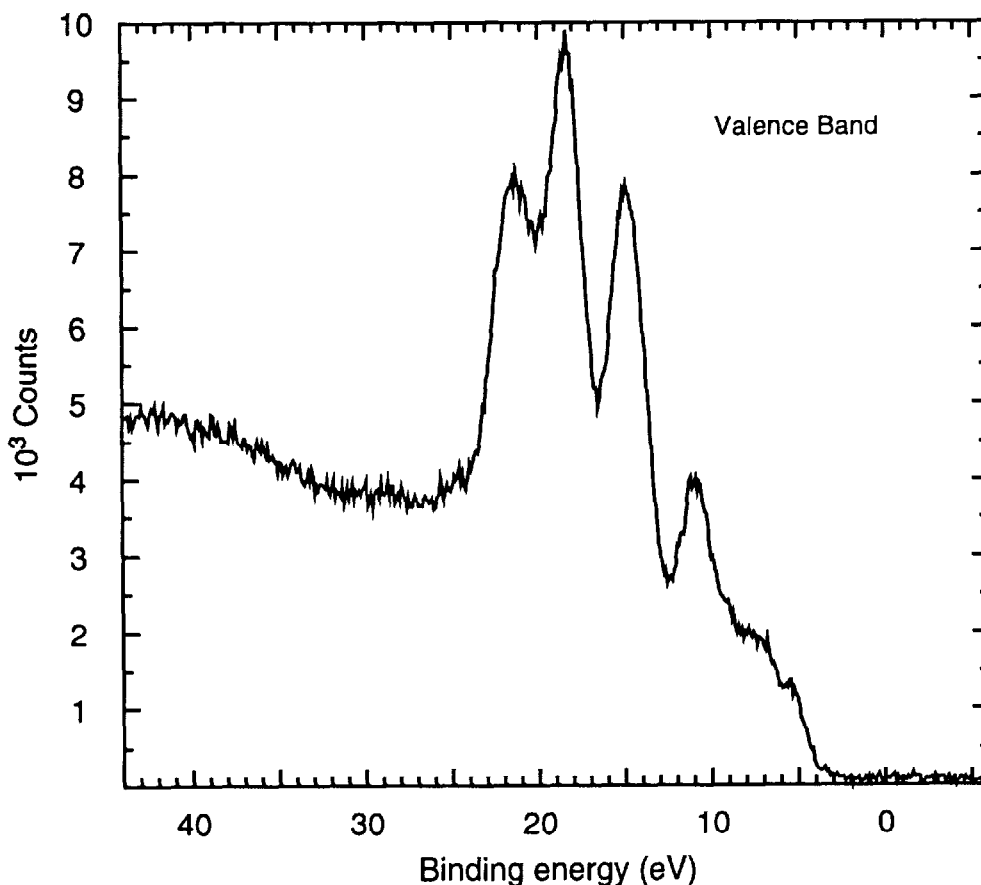
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■ Accession #: 00078-01  
■ Host Material: polystyrene  
■ Technique: XPS  
■ Spectral Region: survey  
Instrument: Hewlett Packard 5950A  
Excitation Source: Al K<sub>α</sub> monochromatic  
Source Energy: 1486.6  
Source Strength: 800 W  
Source Size: 1 mm × 5 mm  
Incident Angle: 26°  
Analyzer Type: spherical sector  
Analyzer Pass Energy: 117 eV  
Analyzer Resolution: 0.2 eV  
Emission Angle: 52°  
Data Acquisition Time: 4200 s  
Dead Time Correction: not specified  
Number of Scans: 10

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■ Accession #: 00078-02  
 ■ Host Material: polystyrene  
 ■ Technique: XPS  
 ■ Spectral Region: C 1s; C shake up  
 Instrument: Hewlett Packard 5950A  
 Excitation Source: Al  $K_{\alpha}$  monochromatic  
 Source Energy: 1486.6  
 Source Strength: 800 W  
 Source Size: 1 mm  $\times$  5 mm  
 Incident Angle: 26°  
 Analyzer Type: spherical sector  
 Analyzer Pass Energy: 117 eV  
 Analyzer Resolution: 0.2 eV  
 Emission Angle: 52°  
 Data Acquisition Time: 1500 s  
 Dead Time Correction: not specified  
 Number of Scans: 12



■ Accession #: 00078-03  
 ■ Host Material: polystyrene  
 ■ Technique: XPS  
 ■ Spectral Region: valence band  
 Instrument: Hewlett Packard 5950A  
 Excitation Source: Al  $K_{\alpha}$  monochromatic  
 Source Energy: 1486.6  
 Source Strength: 800 W  
 Source Size: 1 mm  $\times$  5 mm  
 Incident Angle: 26°  
 Analyzer Type: spherical sector  
 Analyzer Pass Energy: 117 eV  
 Analyzer Resolution: 0.2 eV  
 Emission Angle: 52°  
 Data Acquisition Time: 96000 s  
 Dead Time Correction: not specified  
 Number of Scans: 400  
 Comment: valence band spectral features assigned in Ref. 1