

# Polymethylmethacrylate by XPS

Scott W. Rosencrance, Wayne K. Way, Nicholas Winograd, and David A. Shirley  
Pennsylvania State University, University Park, PA 16802

X-ray photoelectron spectroscopy was used to analyze a thin film of polymethylmethacrylate (PMMA) which was spin cast from a 2% weight solution of PMMA in toluene onto a gold substrate. A Hewlett Packard 5950A ESCA spectrometer was used for this investigation.

**Keywords:** polymethylmethacrylate; PMMA; XPS; polymer; valence band

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

**Accession #:** 00079

**Technique:** XPS

**Host Material:**  
polymethylmethacrylate

**Instrument:** Hewlett Packard 5950A

**Major Elements in Spectrum:** C, O

**Minor Elements in Spectrum:** none

**Printed Spectra:** 4

**Spectra in Electronic Record:** 5

**Spectral Category:** comparison

## SPECIMEN DESCRIPTION

**Host Material:** polymethylmethacrylate

**CAS Registry #:** 9011-14-7

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

**Chemical Name:** not specified

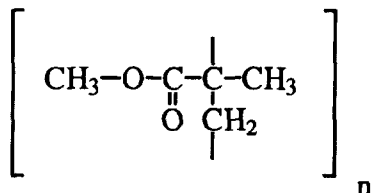
**Source:** Scientific Polymer Products

**Host Composition:** carbon, oxygen

**Form:** thin film

**Lot #:** 28

**Structure:**



**History & Significance:** The average molecular weight was cited as 14000.

**As Received Condition:** The sample was in the form of small beads when received.

**Analyzed Region:** host material

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

**In Situ Preparation:** none

**Charge Control:** A Hewlett Packard 18623A flood gun was operated 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:** C 1s referenced to 285.0 eV

**Quantitation Method:** Sensitivity factors were derived from the Scofield tables (Ref. 1).

## ACKNOWLEDGMENTS

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

## REFERENCES

1. J. H. Scofield, J. Electron. Spectrosc. Relat. Phenom. **8**, 129 (1976).

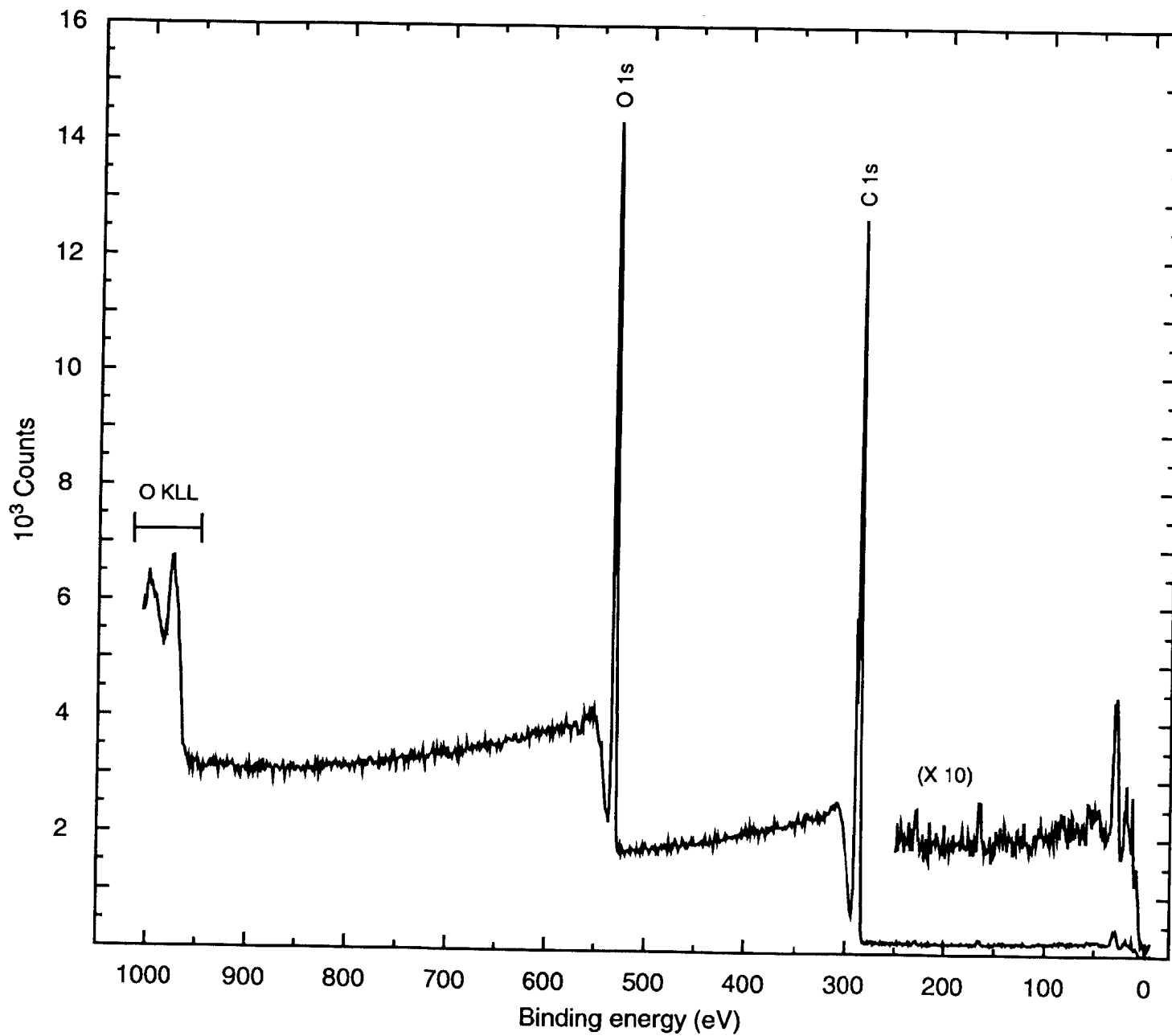
**SPECTRAL FEATURES TABLE**

Spectrum ID #	Element/Transition	Peak Energy (eV)	Peak Width FWHM (eV)	Peak Area (counts)	Sensitivity Factor	Concentration (at. %)	Peak Assignment
3	C 1s	285.0	1.53	370218	1.0	47.4	$\begin{array}{c}   \\ -C- \\   \end{array}$
3	C 1s	286.6	1.41	126723	1.0	16.2	O-CH <sub>3</sub>
3	C 1s	288.8	1.28	105365	1.0	13.5	O-C=O
4	O 1s	530.3	1.48	227980	2.93	10.0	C=O
4	O 1s	531.9	1.74	295164	2.93	12.9	C-O-C

**ANALYZER CALIBRATION TABLE**

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

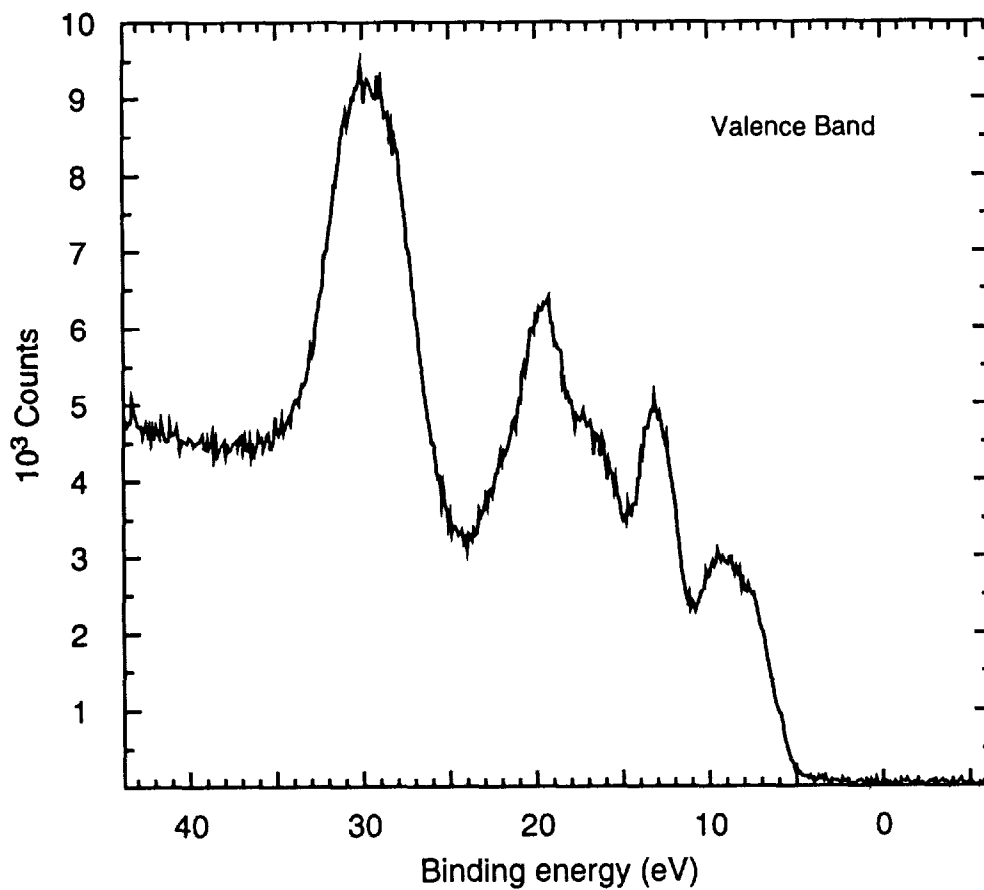
<sup>a</sup>A gold plated copper substrate was used.



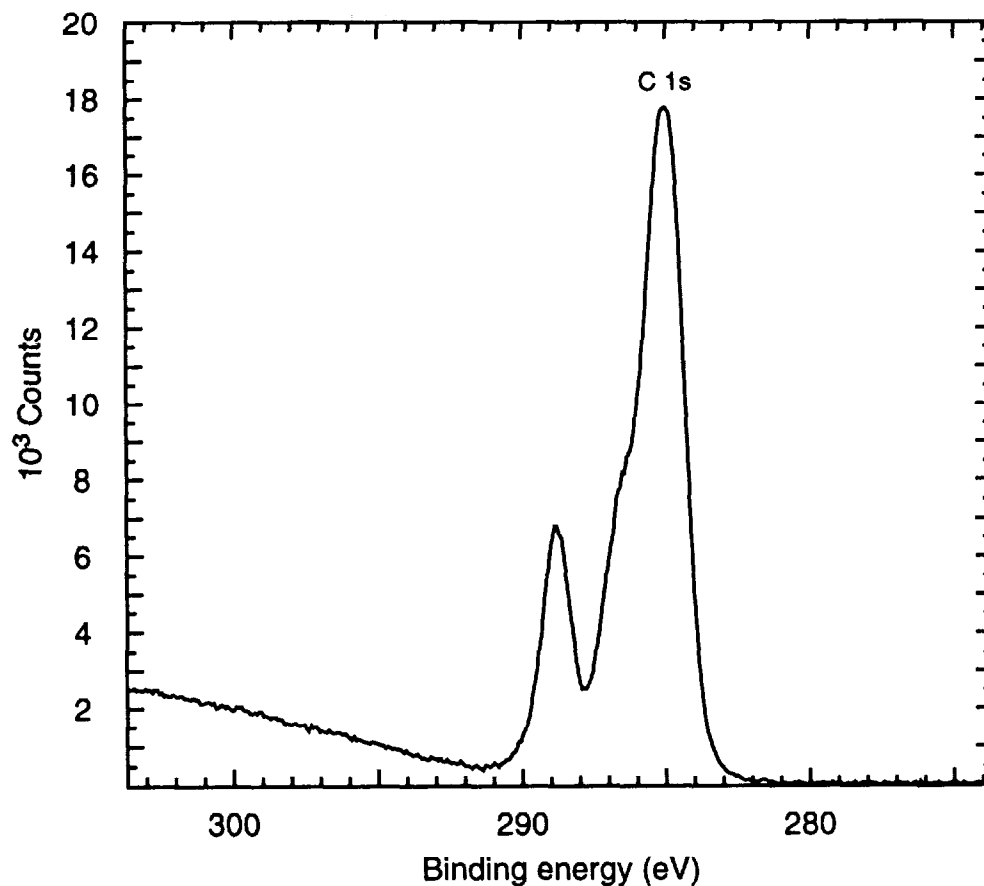
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■ Accession #: 00079-01  
■ Host Material: polymethylmethacrylate  
■ Technique: XPS  
■ Spectral Region: survey  
Instrument: Hewlett Packard 5950A  
Excitation Source: Al K<sub>α</sub> monochromatic  
Source Energy: 1486.6  
Source Strength: 800 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: 10500 s  
Dead Time Correction: 0  
Number of Scans: 25  
Comment: C 1s is referenced to 285.0 eV

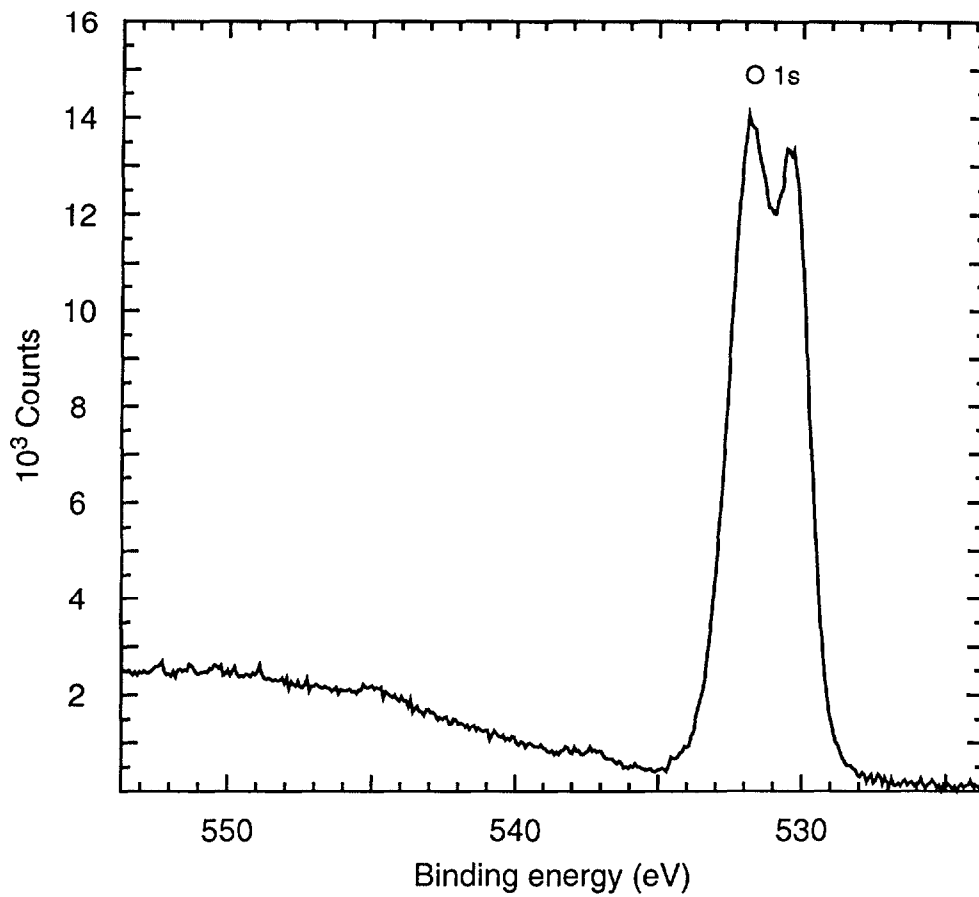
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■ Accession #: 00079-02  
 ■ Host Material: polymethylmethacrylate  
 ■ Technique: XPS  
 ■ Spectral Region: valence band  
 Instrument: Hewlett Packard 5950A  
 Excitation Source: Al  $K_{\alpha}$  monochromatic  
 Source Energy: 1486.6  
 Source 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: 72000 s  
 Dead Time Correction: 0  
 Number of Scans: 300



■ Accession #: 00079-03  
 ■ Host Material: polymethylmethacrylate  
 ■ Technique: XPS  
 ■ Spectral Region: C 1s  
 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: 4950 s  
 Dead Time Correction: 0  
 Number of Scans: 25  
 Comment: C 1s is referenced to 285.0 eV



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■ **Accession #:** 00079-04  
■ **Host Material:** polymethylmethacrylate  
■ **Technique:** XPS  
■ **Spectral Region:** O 1s  
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: 4950 s  
Dead Time Correction: 0  
Number of Scans: 25

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