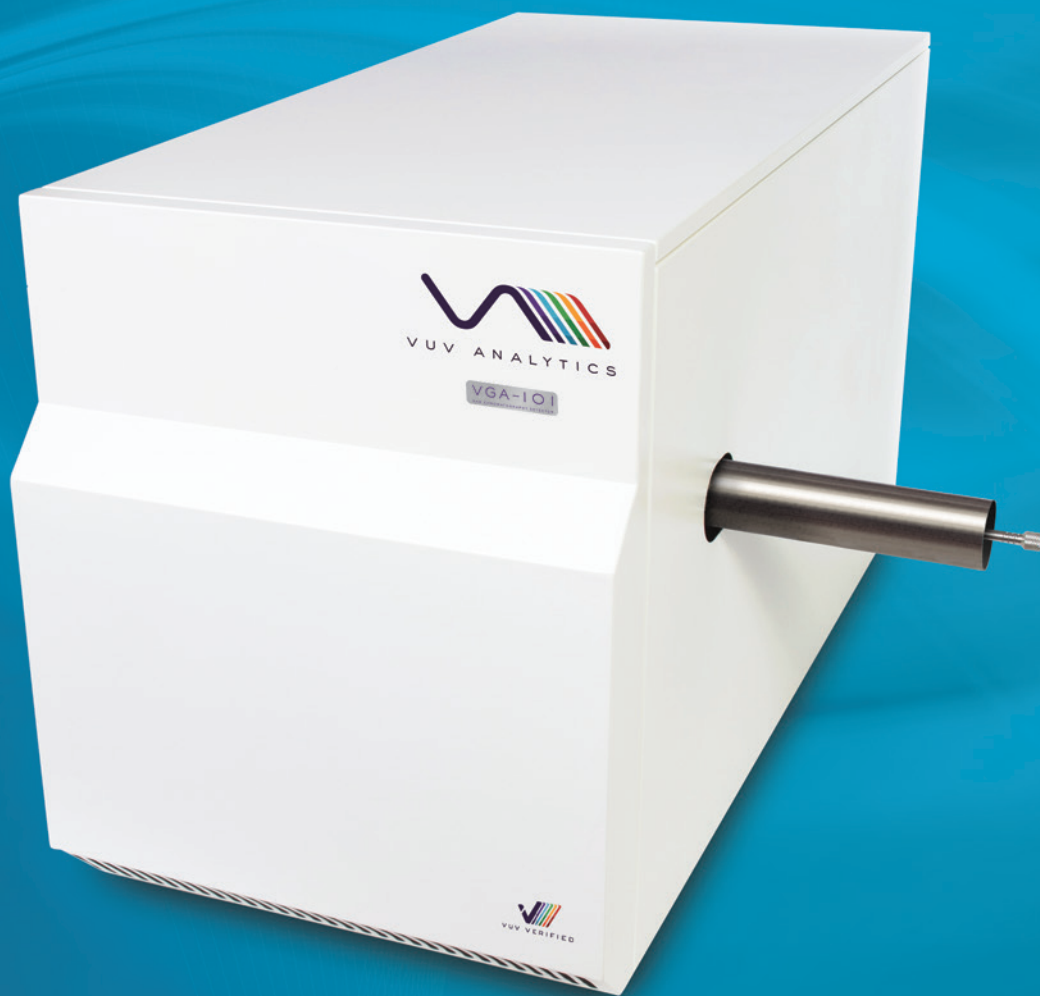


If your current method
is leaving you in the dark...

Shine a new light on it.



VGA-101

GAS CHROMATOGRAPHY DETECTOR



VUV ANALYTICS



VUV VERIFIED

Gas chromatography in a new light.

Synchrotron VUV spectra quality delivered to your benchtop by the VGA-101

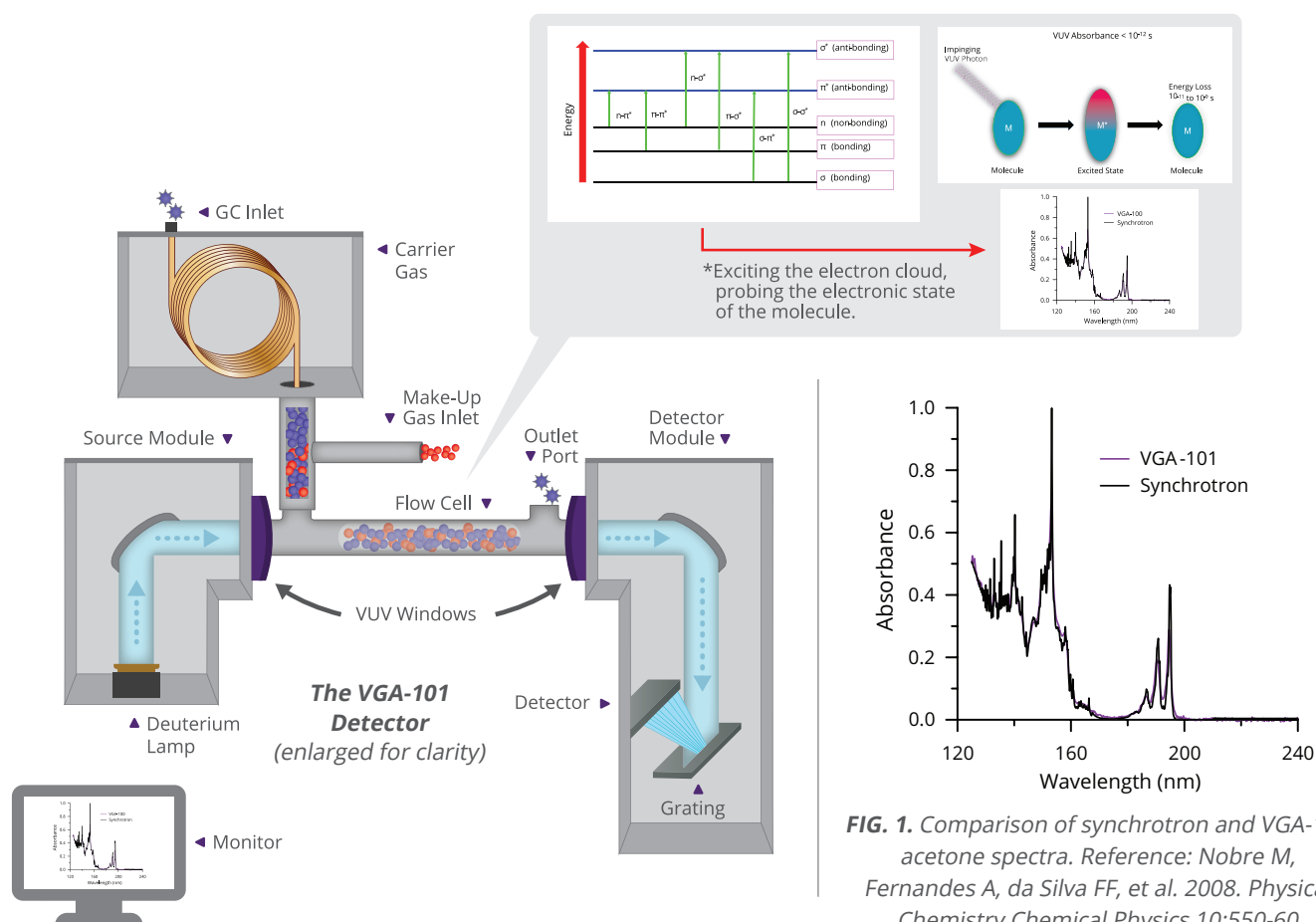


FIG. 1. Comparison of synchrotron and VGA-101 acetone spectra. Reference: Nobre M, Fernandes A, da Silva FF, et al. 2008. *Physical Chemistry Chemical Physics* 10:550-60

Vacuum ultraviolet (VUV) spectroscopy provides unique fingerprint identification and quantitation of compounds

The VUV absorbance region is an ideal fit with gas chromatography (GC) detection due to the fact that almost every chemical compound absorbs strongly in this wavelength range (115 – 185 nm). Photons in this regime are capable of producing electronic transitions in virtually all chemical bonds, especially from a ground state to an excited state designated as $\sigma \rightarrow \sigma^*$ and $\pi \rightarrow \pi^*$ transitions,

which cannot be probed in traditional UV/Vis spectroscopy. The VUV region had historically been restricted to bright source synchrotron facilities due to significant background absorption and experimental difficulties that have long plagued the implementation of this spectroscopic region. The VGA-101 VUV detector is a bench-top spectrometer capable of full VUV spectrum detection.

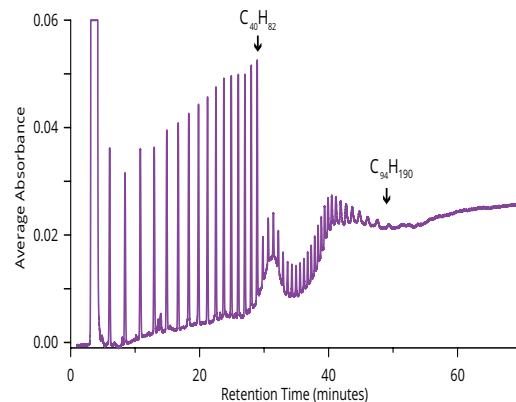
Expanded operating parameters widen the application spectrum.

The VGA-101 offers additional capabilities to the VUV absorbance detection platform pioneered by the VGA-100. Analysis requiring temperatures exceeding 400 °C and measurement between

120 – 430 nm can now be routinely performed. Using spectral filters in a targeted wavelength region increases analyte sensitivity, ensuring quantitation at very low concentration levels.

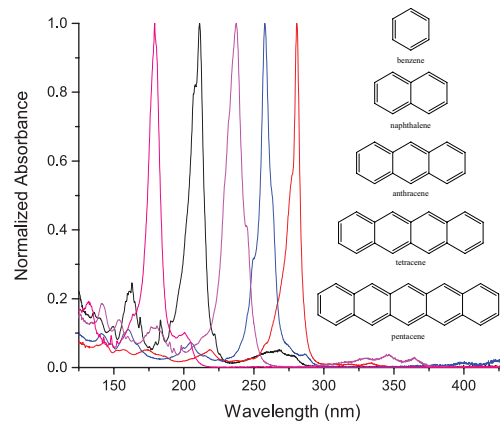
Routine identification and quantitation of high boiling point compounds

FIG. 2. VUV absorbance spectrum of a complex hydrocarbon mixture analyzed at 430 °C



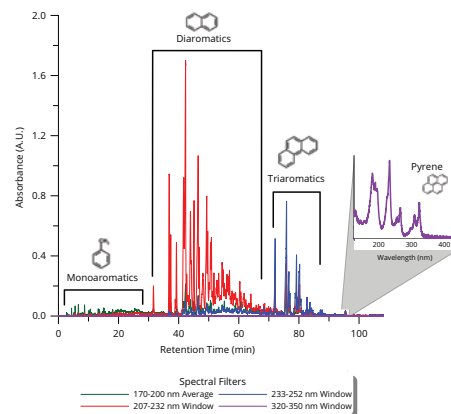
A wider wavelength detection range provides new spectroscopic data

FIG. 3. A VUV spectrum comparison of acene compounds with increasing benzene ring count



Spectral filters improve analyte sensitivity throughout the VUV spectrum

FIG. 4. Spectral filter comparison of diesel fuel fraction analyzed from 120 – 350nm



Unambiguous Analytical Answers for the Most Complex Applications

All gas phase molecules absorb strongly in the vacuum ultraviolet (VUV) region, yet analytical detection and measurement of VUV absorption was not addressed until the launch of the VGA-100. The VGA-100 is a universal mass-sensitive gas chromatography (GC) detector that provides both qualitative and quantitative data with excellent sensitivity and unparalleled selectivity.

The VGA-101 is the latest innovation in vacuum ultraviolet detection featuring an expanded wavelength spectrum and a higher allowable maximum operating temperature. An expanded wavelength spectrum of 120 – 430 nm provides unique selectivity for complex structures such as polyaromatic hydrocarbons (PAHs). The ability to operate the VUV detector as high as 430 °C allows GC analysis of high boiling point compounds.

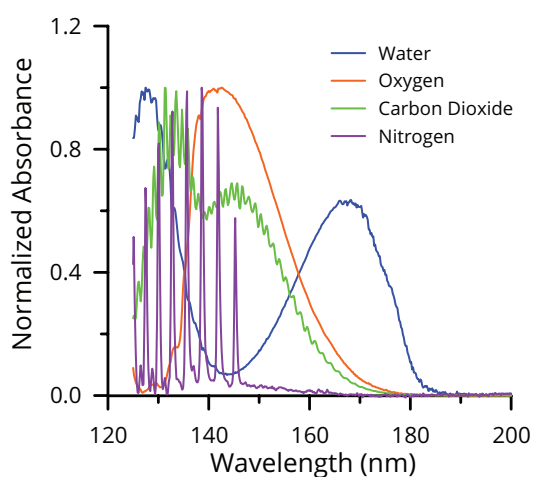


FIG. 5. Unique VUV absorbance spectra of water, oxygen, carbon dioxide, and nitrogen

Know more about your analyte using the VGA-101

- **Universal detection**
 - > Nearly everything has a unique absorption fingerprint in the VUV spectrum
- **Measurement parameter flexibility for advanced GC analysis**
 - > Data collection from 120 – 430 nm
 - > Operating temperature heating up to 430 °C for high boiling point compound analysis
- **Unique selectivity allows unambiguous compound identification**
 - > Easily deconvolve co-eluting analytes
 - > Clear and easy isomer differentiation
 - > Baseline chromatographic resolution not required
- **Excellent measurement sensitivity**
 - > Consistently low picogram limits of detection
 - > Spectral filters increase analyte sensitivity in targeted wavelength regions
- **Data is both highly quantitative and qualitative**
 - > Mass sensitive measurement of individual components within complex mixtures
 - > Spectral data provides unique fingerprint for all compounds measured
- **Non-destructive analysis**
 - > No ionization required, analyze intact molecules
- **Reliable & Easy to use**
 - > No routine maintenance necessary, no vacuum pumps
 - > No calibration required – 1st principle detection provides a predictable linear response

A universal detector for every application

Because everything absorbs in the vacuum ultraviolet spectrum, identification and quantitation of compounds is possible for a broad range of industries. The VGA-101 provides new detection

possibilities to customers in environmental research, oil & gas, forensics, fragrances & flavors, petrochemical, specialty gas, agrochemical, food & beverage safety, and life science.

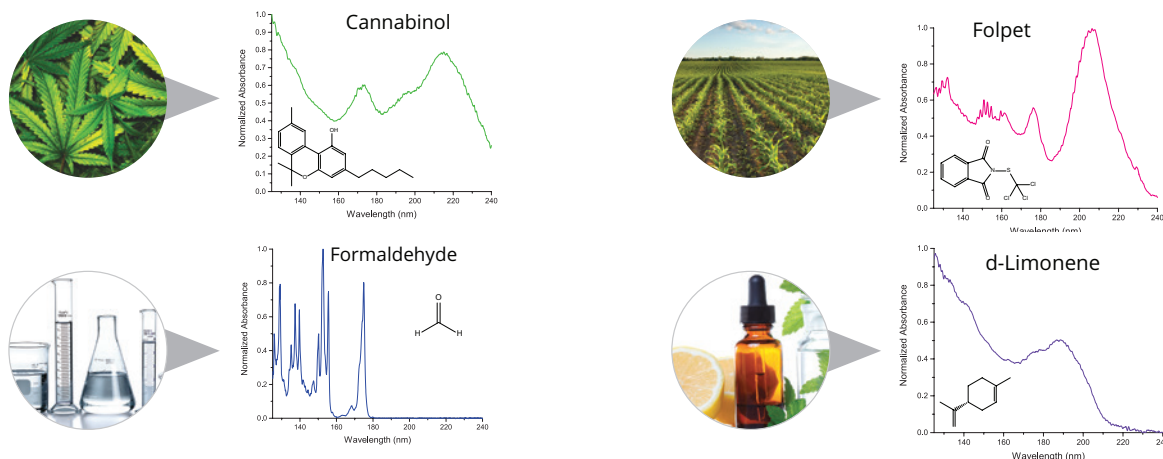


FIG. 6. VUV absorbance spectra demonstrating VGA-101 utility in a number of industries including drug forensics, health and safety, pesticides, flavoring, and cosmetics

New solutions to old analytical problems

The determination of water content is a required measurement in many sectors of chemical industry, and is inherently difficult to measure due to its ubiquitous presence. Traditionally the water content of materials including organic solvents has been determined using Karl Fischer Titration or GC-TCD. However, both of these techniques are limited in sensitivity, reproducibility, or ease of use. GC-VUV offers a quantitative and repeatable

alternative for the determination of water in organic solvents while also allowing for unique spectral identification of other chemical components in the sample. The key benefits of this new methodology include multiple component analysis, low detection limits (1 – 10 ppm in most solvents), excellent precision (< 5% RSD), and independence from toxic and expensive reagents.

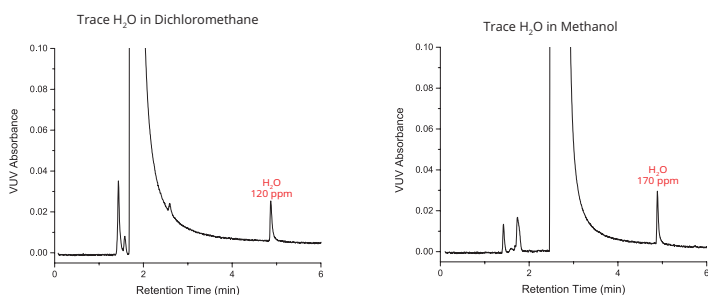


FIG. 7. Water determination in common solvents using Supelco® Watercol 1900 GC columns

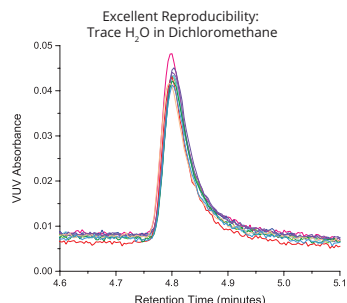


FIG. 8. Reproducibility and detection limits of water determination

Parameter	Setting	Unit
Average Area	0.00187	AU
% RSD	4.68	-
Conc. Background	100	ppm
MDL	13	ppm
Average Height	0.035	AU
RMS Noise	.00029	AU
S/N	120	-
LOD	2.5	ppm

Unique selectivity resolves isomers within complex mixtures

It is quite common for closely related isomers to have similar or even identical retention times, resulting in co-elution from the column. For example, the meta- and para- isomers of xylene are particularly difficult to resolve chromatographically due to their similarity in structure. Further complicating their analysis, these isomers are virtually indistinguishable based on electron ionization mass spectral profiles. However, these two compounds can be easily distinguished

based on their VUV spectral response. Measured VUV spectra can be matched against an existing compound-specific absorption cross section library to rapidly identify compounds in complex mixtures. A simple linear absorbance fitting routine provides the ability to deconvolve co-eluting peaks, as shown in the figures below where a single sharp peak was deconvolved into additive contributions from both m- and p-xylene isomers.

Spectral deconvolution of m&p Xylene

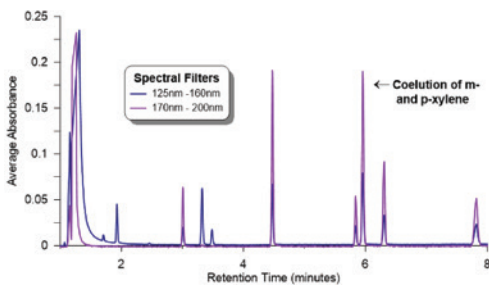


FIG. 9. Xylene isomer VUV absorbance sensitivity comparison using different spectral filters. Spectral filters can be applied post-run to enhance analyte specificity.

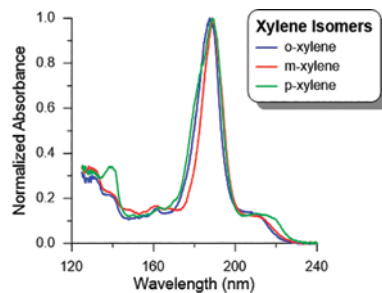


FIG. 10. VUV absorbance spectra of overlapping xylene isomers.

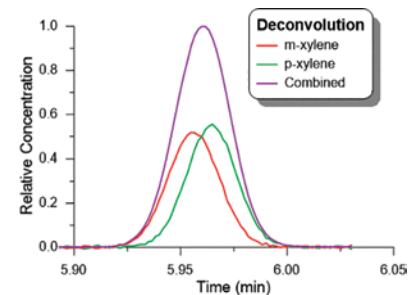


FIG. 11. Deconvolution of the overlapping chromatographic signals for m- and p-xylene.

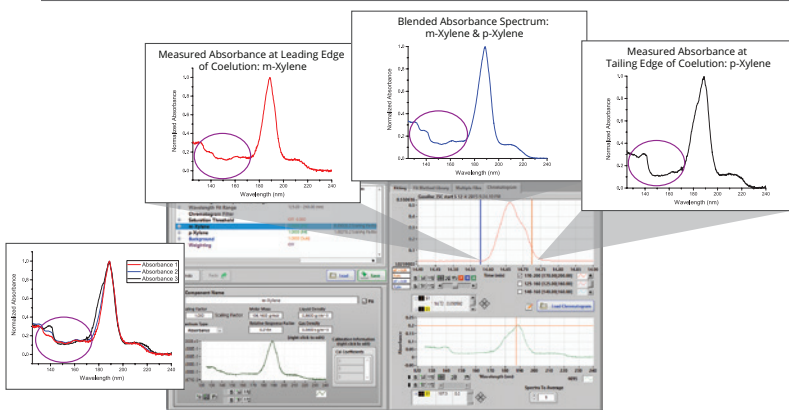


FIG. 12. Matching the peaks of interest to compounds in the VUV absorbance library. Every data point in the sum absorbance peak has a unique spectrum reflecting the contribution of known compounds at a given retention time.

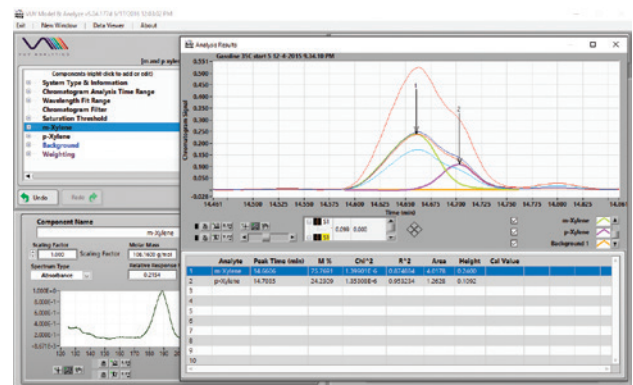


FIG. 13. Deconvolution of m- and p-Xylene allows quantitation of each isomer.

PARAMETER	VUV ANALYTICS VGA-101	NOTES
Light Source	Deuterium lamp	
Wavelength Range	120 - 430 nm	
Wavelength Accuracy	±0.2 nm	
Wavelength Reproducibility	0.05 nm	
Type of Response Spectral	Universal	*H ₂ , He, Ar are transparent
Bandwidth Maximum	<1 nm	
Acquisition Rate Data	90 Hz	
Collection Interval	11 ms	
Response Characteristic	Absorption versus Wavelength	
Measurement Output	Identity, Concentration	*H ₂ , He, Ar are transparent
Detected Species	All compounds and classes	
Typical IDLs (pg on Column)	Benzene: 15 Nicotene: 19 Naphthol: 30 Derivitized β-estradiol: 30 Octane: 56 Methanol: 169 Captan: 186 Water: 246	
Linear Range	3-4 orders	
Temperature Range	Ambient - 430 °C	
Carrier Gases	H ₂ , N ₂ , or He	
Makeup gas	Ar, He, H ₂ , N ₂	
Flow Cell Dimensions	10 cm pathlength, <40 µL cell volume	
Instrument Dimensions	30" x 13" x 17", or 76.2 x 33 x 43.2 cm	
Deuterium Lamp Lifetime (hours)	>2000	Lamp intensity half-life at 250 nm
Weight	120lbs, or 54.4kg	
Power Input Voltage	100/240V	
Power Consumption	<700 VA	
Operating System Requirements	Quad Core processor, 1080 x 1920 Monitor, Minimum Memory 8G, Hard Drive Min 250G, Windows 7, 8, or 10 (64 bit)	
Additional Facilities Requirements	CDA connection 99.999% N ₂ connection, typical 40 mL/min purge requirement	

"The VUV detector is a powerful new tool in the GC toolbox."

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Professor & Shimadzu
Distinguished Professor of Analytical Chemistry
The University of Texas at Arlington



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