Abstract

Differential Optical Absorption Spectroscopy (DOAS) technique is the one of techniques for measurement, analysis and managing air pollution, study the chemical properties of trace gases in the atmosphere, identification of critical (peak) value to determine the concentration of trace gases that cause an air pollution in industrial-urban locations, and are use in evaluating criteria of photochemical or smog pollution cases of fewer days, and in analysis of wind direction.

According to these issues the (DOAS) technique has been developed to become one of techniques that has high order in practical performance based on UV-Visible and near infrared region at spectral range of (200-1100nm) wavelength absorption by molecules of gases in atmosphere. The experimental work of this thesis has been focused on calibration of the system with laboratory experiments to detect many atmospheric gases which are, nitrogen oxides (NO, NO_2 and NO_3 radical).

DOAS technique is based on the principle of optical absorption by molecule of gas over several meters to many kilometers length, DOAS gives average concentration measurement lead's to general pollution estimation at long distances, and consequently avoids local perturbation events in points measurements, the DOAS technique provides typical database by using the language of C# compared with results get it from experimental measurement obtainable low cost test and best resulted.

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List of Symbols

Symbol	Caption	Unit
$E_{exci.}$	Excitation Energy of Upper Level	Cm^{-1}
ΔE	The Excitation Energy for Radiation	Cm^{-1}
I	Average Intensity of Light	(W/cm^2)
ppm	Part per million	
LOD	Limits of Detection	
ε_o	Permittivity of Free Space = 8.854×10^{-14}	(F/m)
c	Velocity of Light = 3×10^8	(m/s)
α	Absorption Coefficient	$(cm)^{-1}$
λ	Wavelength	(nm)
$\Delta\lambda$	Wave different	(nm)
h	Planks Constant = 6.62×10^{-34}	(J . s)
d	Distance	m
t	Time	S
$S(\lambda)$	Spectral Response	(A/W)
$Q.E(\lambda)$	Quantum Efficiency at Wavelength λ	(%)
K_B	Boltzmann's Constant = 1.38×10^{-23}	(J/K)
L	Path Length	(m)
$I_o(\lambda)$	Initial Intensity	(W/cm^2)

$I_{tr}(\lambda)$	Transmitted Intensity	(W/cm^2)
$\bar{c}$	The Average Concentration	$Mole./cm^3$
$\sigma(\lambda)$	Absorption Cross Section of the Substance	cm^2
$\sigma_i^-(\lambda)$	Rapidly Varying Cross Section	cm^2
$\sigma_i^s(\lambda)$	Slowly Varying Cross Section	cm^2
R	Reflectance	%
α	Deviation	Degree& Radian
$\varepsilon_R(\lambda)$	Rayleigh(λ) Extinction Coefficient	cm^{-2}
$\varepsilon_M(\lambda)$	Mie(λ) Extinction Coefficient	$cm^{-(1..3)}$
D (λ)	Optical Density	
Ψ	Radiation Energy per Unit Time	(Joule/sec) =Watt
A	Radiation Area	cm^2
Ω	Solid Angle in Steroidal	Sr
ΔR	The Distance Interval to be Averaged	m
K	Constant of the System	
E_0	The Radiation Energy Emitted by the Laser	Joule
C s(R)	Concentration of Backscattering	$Mole/cm^3$, g/l or Molary
C A(R)	Concentration of the Absorbers	$Mole/cm^3$, mg/l or Molary.
pa	Pascal (=10^{-5} bar =10^{-5} atm.=760×10^{-5} mmHg= 760×10^{-5}torr)	N/m^2

List of Abbreviations

Differential Optical Absorption Spectroscopy	DOAS
Principal Components Analysis	PCA
Improvised Explosive Devices	IED
Charge Coupled Device	CCD
Intensified Charge Coupled Device	ICCD
Fiber Optics Cable	FOC
Total Internal Reflection	TIR
Silicon Detector	Si D
Differential Absorption Lidar	DIAL
Cavity Ring Down Spectroscopy	CRDS
High Resolution	HR
Ultraviolet-Visible and Near Infrared	UV/VIS/NIR
Cavity Enhanced Spectroscopy (CEAS)	CEAS
Correlation Spectroscopy	COSPEC
The Cabauw Inter Comparison Campaign of Nitrogen Dioxide Measuring Instruments	CINDI
Multi-Axis Differential Optical Absorption Spectroscopy	MAX DOAS
And Others (et alia)	et al
Automatic Monitoring Instrument	API
Percent Difference	PD
a. u.	Altitude unit

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