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Non-Destructive test on Sun and Shadow Plant by Photoacoustic spectroscopy (PAS)

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Abstract: *In this study, used Photoacoustic spectroscopy (PAS) in Non-Destructive test on the plant that growth in Sun and Shadow (Bougainvillea spp 1l in shadow, Bougainvillea spp 1 in sun, Citrus Sanseis in sun, Citrus Sanseis in shadow, Canna Indicia in sun, Canna Indicia in shadow, Ixora Coccinnia in sun, Ixora Coccinnia in shadow, Bougainvillea Spp2 in sun, Bougainvillea Spp2 in sun, Citrus Paradisi in shadow and Citrus Paradisi in sun). In (PAS) the absorbed light is transformed to an acoustic wave. A Photoacoustic spectrum consist of a plot of the intensity of the acoustic signal against the excitation wavelength or another quantity related to the photon energy of the modulated excitation. By Photoacoustic spectroscopy (PAS) have been detected the following vibration bonds (S-S stretching, S-S stretching , C-H stretching C-S stretching ,S=O stretching , N-H stretching and O-H stretching) on the different wavelengths according the plant and it place growth .*

Keywords: Photoacoustic spectroscopy, Non-Destructive test, plant leaves, growth in sun and `growth in shadow

1. Introduction

Photoacoustic spectroscopy (PAS), sometimes also termed optoacoustic spectroscopy, is used to study energyl emission resulting from nonradioactive de-excitation following absorption of radiation. Several reviews have already been published on the method in general [1,2] and its application in biology [3,4,5] . The detection of the photoacoustic effect dates back to experiments of Alexander Graham Bell [6], John Tyndall, Wilhelm Röntgen and Lord Rayleigh in 1880. For the history of PAS see [7] . It was not until 1973 that photoacoustic spectroscopy started to be used in a wide range of different applications. This "rediscovered" technique provides the following main advantages over the conventional types of spectroscopy. It allows the characterization and analysis of substances in highly light-scattering and opaque materials such as powders (drugs, insulators, \and metals), amorphous solids (glasses), gels (films), suspensions (bacteria, algae, cell organelles) and tissues (leaves, skin). Non-destructive and in vivo studies at different subsurface levels of a material (depth profile analysis), studies of the optical and energy properties of the sample, gathering information about the de-excitation states of molecules (e.g. energy state, quantum yield) and about the lifetime of the intermediates of chemical reactions.These major advantages make PAS particularly suitable for studying biological material in vivo. In plant material PAS has been used since 1976 for the spectroscopic characterization and detection of pigments in phytoplankton [8] and tissues or cell layers including depth profile analysis [9,10] . PAS was used for measuring photosynthetic activity by comparing the heat emission of active and inactive sample [11]. PAS in combination with other types of spectroscopy (e.g. fluorescence and absorption) and gas exchange studies seems to be a valuable tool to clarify a variety of questions in today's photosynthesis research. Principle of the photoacoustic effect: Non-radiative de-excitation processes in a sample cause energy emission. If the sample is excited by absorption of intermittent (modulated) light energy pulses are emitted with the same modulation frequency as that of the incident excitation light. These energy pulses create changes in the construction of sample and can thus be detected as an acoustic signal. Only a small number of photoacoustic spectrometers are commercially available. Most of the results presented up to now were achieved with "homemade" apparatus. For excitation one may use a strong conventional light source e.g. incandescent arc lamps or a laser. Excitation wavelength is selected and scanned by means of a monochromator in the spectral range of the ultraviolet, visible and near infrared. The light beam falling upon the sample is periodically interrupted (modulated), e.g. by a rotating sector (chopper). The modulation frequency can be varied within a given range, normally between I Hertz and several Kilohertz (acoustic frequency). Parameters determining the strength of the photoacoustic signal (optimum signal/noise ratio) The height of the photoacoustic signal is determined by the characteristics of the spectrometer and of the sample [10,11] . To receive a high signal/ noise ratio the following parameters are of importance: instrumentation: high photon flux of the excitation light with precautions concerning photodestruction of the samples . appropriate modulation frequency, normally between 5 Hz to 500 Hz . low temperature thin gas layer above the sample sample:
high light absorption of the sample . high quantum yield for non-radiative de-excitation of the sample . low thermal conductivity of samples with high light absorption . high thermal conductivity of optically more transparent samples (with lower light absorption) . . large sample surface (to allow a good thermal transfer from sample into the gas phase of the sample compartment).

Experimental Arrangement

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As the photoacoustic and related photo thermal phenomena comprise a large diversity of facets, there exist a various detection technique which rely on the acoustic or thermal disturbances caused by the absorbed radiation, the selection of the most appropriate scheme for a given application depends on the sample, the sensitivity to be achieved, ease of operation, ruggedness, and any requirement and any require for non-contact detection . Experimental schemes for photoacoustic studies on solid sample includes the measurement of the generated vibration bonds wave either directly in the sample with a piezoelectric sensor for the pulsed regime, or indirectly in the USB 2000 spectrometer which is in contact with the sample by a computer as show in fig (1) .

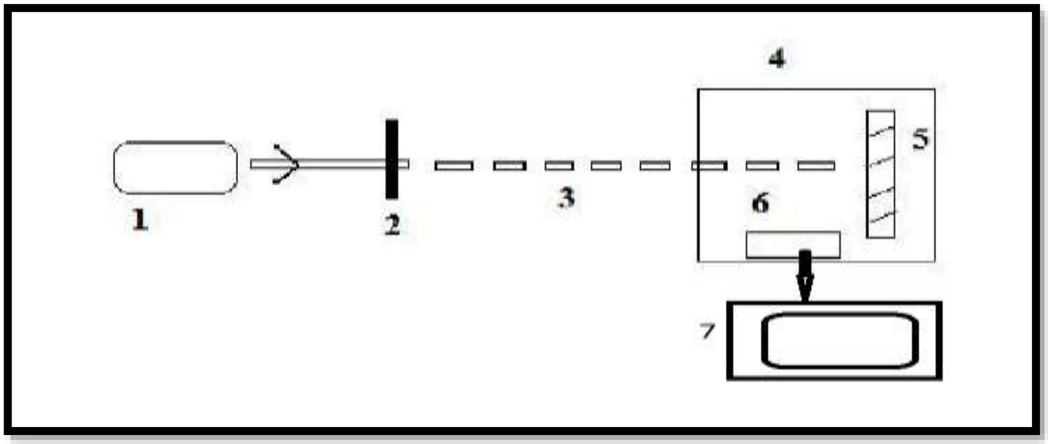

Fig (1) typical experimental arrangements used for Photoacoustic spectroscopy. (1) Light source (2) the chopper (3) chopped light (4) photoacoustic cell (5) sample (6) USB-2000 spectrometer (detection sensors) (7) computer

Results : After arrangement the experimental to study vibration bonds of five samples of plant that growth in Sun and Shadow by the Photoacoustic spectroscopy (PAS) (Non-Destructive test) as showing in the results blow.

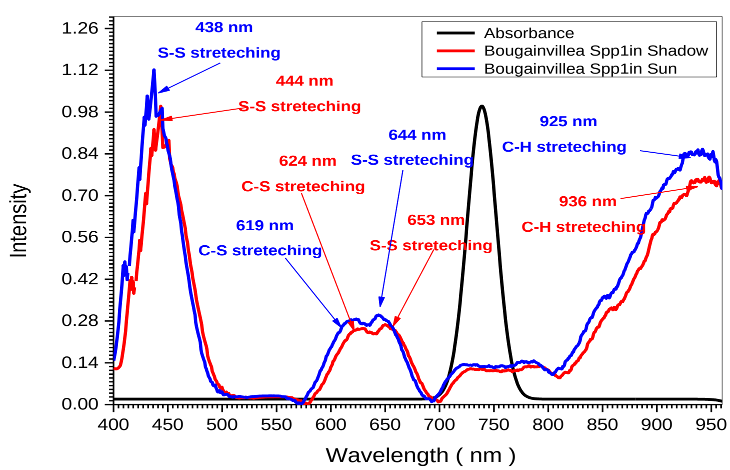

Fig (2) the experimental acousto-optic Modulators curve relation between wavelength and acousto-optic modulators intensity of Bougainvillea Spp1 samples growth in sun and same plant `growth in shadow

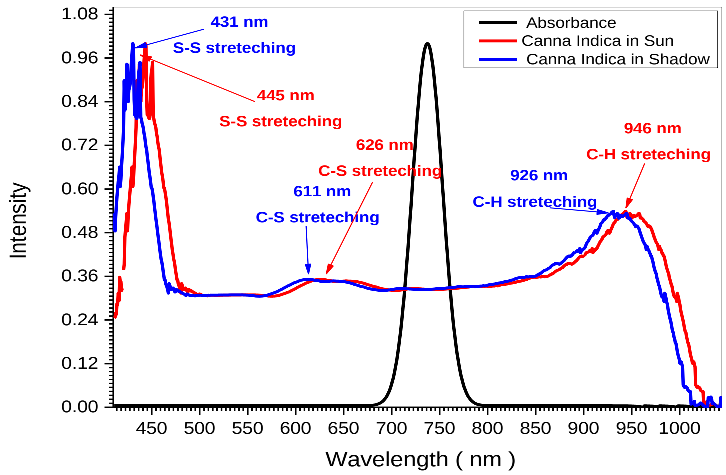

Fig (3) the experimental acousto-optic Modulators curve relation between wavelength and acousto-optic modulators intensity of Canna Indica samples growth in sun and same plant `growth in shadow

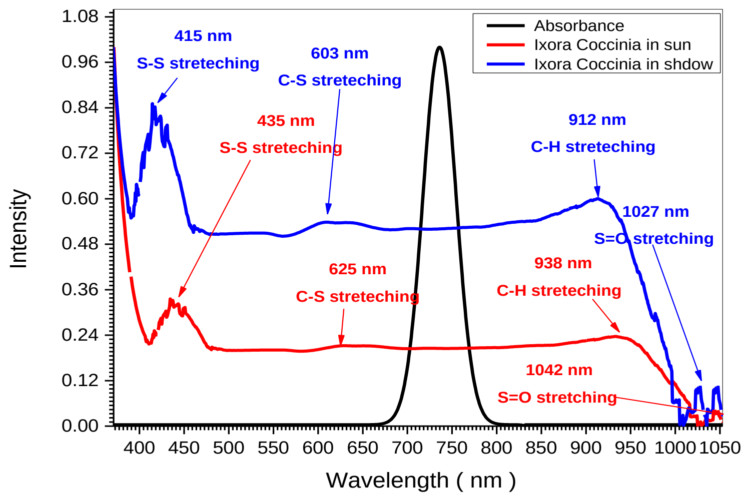

Fig (4) the experimental acousto-optic Modulators curve relation between wavelength and acousto-optic modulators intensity of Ixora Coccinia samples growth in sun and same plant `growth in shadow

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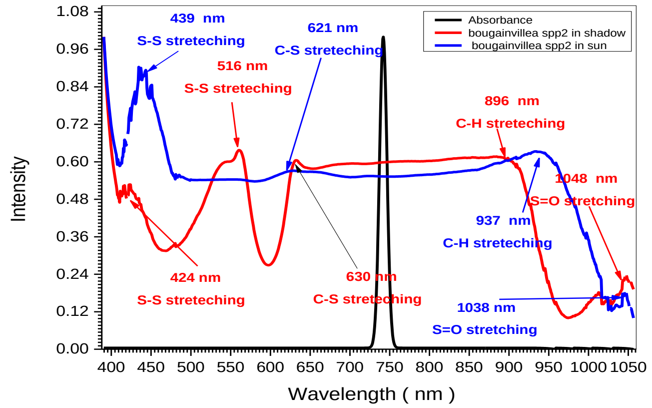

Fig (5) the experimental acousto-optic Modulators curve relation between wavelength and acousto-optic modulators intensity of Bougainvillea Spp2 samples growth in sun and same plant `growth in shadow

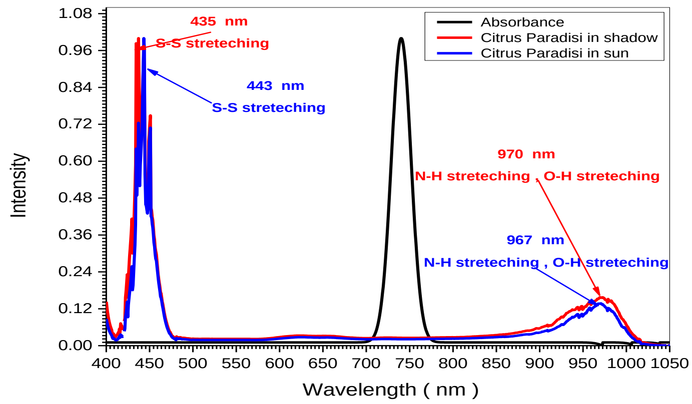

Fig (6) the experimental acousto-optic Modulators curve relation between wavelength and acousto-optic modulators intensity of Citrus Paradisi samples growth in sun and same plant `growth in shadow

Table (1) show the samples and Wavelength of some bands organic compounds (nm)

No	samples	Wavelength of some bands organic compounds (nm)				
		S-S stretching	C-S stretching	C-H stretching	S= O stretching	N-H and O-H
1	Bougainvillea spp 1l in shadow	444nm 653nm	624nm	936nm		
2	Bougainvillea spp 1 in sun	438nm 644nm	619nm	925nm		
3	Citrus Sanseis in sun	408nm	606nm	905nm		
4	Citrus Sanseis in shadow	400nm	600nm	900nm		
5	Canna Indicia in sun	445nm	606nm	946nm		
6	Canna Indicia in shadow	431nm	611nm	926nm		
7	Ixora Coccinnia in sun	435nm	625nm	938nm	1042nm	
8	Ixora Coccinnia in shadow	415nm	603nm	912nm		
9	Bougainvillea Spp2 in sun	516nm 424nm	630nm	896nm	1048nm	
10	Bougainvillea Spp2 in sun	439nm	621nm	937nm	1038nm	

Discussion

In fig(2) showing the bonds that generated from leaves of Bougainvillea Spp1 growth in sun and shadow are shaken (S-S stretching at (438,644) nm for sun and(444, 653) nm f or shadow, C-H stretching at 619 nm for sun and 624nm f or shadow and C-S stretching at 925 nm for sun and 936 nm f or shadow). For the Citrus Sinesis plant show in fig(3) the bonds are shaken (S-S stretching at (408) nm for sun and(400) nm f or shadow, C-H stretching at 906 nm for sun and 900nm f or shadow and C-S stretching at 606 nm for sun and 600 nm f or shadow) . Fig(4) the relation between the wavelength the intensity of acoustic optic modulation that generated from leaves of Canna Indica growth in sun and same plant growth in shadow the bonds are shaken (S-S stretching at (445) nm for sun and(431) nm f or shadow, C-H stretching at 946 nm for sun and 926 nm f or shadow and C-S stretching at 925 nm for sun and 936 nm f or shadow) . Fig(5) showing the acoustic optic modulation that generated from leaves of Ixora Coccinia the bonds are shaken (S-S stretching at (435) nm for sun and(415) nm f or shadow, C-H stretching at 938 nm for sun and 912 nm f or shadow and C-S stretching at 625 nm for sun and 603 nm f or shadow and S=O stretching at1042nm for sun and 1027nm for shadow) . In fig(6) showing the acoustic optic modulation that generated from leaves of Bougainvillea Spp2 growth the bonds are shaken (S-S stretching at (439) nm for sun and(516-424) nm f or shadow, C-H stretching at 937 nm for sun and 896 nm f or shadow and C-S stretching at 621 nm for sun , 630 nm f or shadow and S=O stretching at 1038nm for sun and 1048nm for shadow6) .

Conclusions

Acoustic optic modulation that generated from leaves of plant that growth in sun and shadow in different bonds vibration position, and the reason of different position vibration bonds come from the concentration of components, which consist of the plant leaves.

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