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Innovation In The Technique Of Thermal Lens Spectroscopy For Water

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Abstract: This Paper Presents An Original Idea To Be Applied In Photothermal Techniques, Especially In The Thermal Lens Technique For Spectroscopic Detection, Where Instead Of Using Lasers Modulated By A Mechanical Chopper, An Electronic Card And Driver Are Used To Modulate Any Laser Diode Under The Scheme That Is Proposed In The Experiment That Applies For The Analysis In The Photothermal Techniques Presented. The Stability Of The Modulation Allows Us To Guarantee An Adequate Response Of The Experiment With The Amplitude And Face According With The Frequency.
Keywords: Control, Diode Laser, Hardware, Stability.

I. INTRODUCTION

Photothermal Techniques Have An Infinity Of Applications Today Such Is The Case Of Determining The Coefficient Of Water Absorption, Accurate Knowledge Of The Water Absorption Spectrum Is Vital For Many Branches Of Science And Technology. Although It Was Investigated By Different Techniques, Particularly Between 300 To 450 Nm, There Is Still Significant Disagreement Among Various Studies [1-4].From 3 To 0.3 Mm, The Coefficient Of Water Absorption Falls To 8 Orders Of Magnitude, Reaching A Minimum Of 0.4. However, The Wavelength And The Value Of The Minimum Absorption Are Still Unclear. The Efficiency Of The Conventional Transmission Methods Used To Measure The Absorption Of Highly Transparent Materials Is Generally Limited By The Dispersion And Reflection Of The Surface.Photothermal Techniques Such As Photoacoustic, Photothermal Deflection And Thermal Lens, Are Insensitive To Dispersion And Have Been Used In Ultra-Sensitive Spectroscopy [5-7]. Some Researchers Had Obtained A Minimal Absorption Of 420 Nm Using Photothermal Deflection And The Integration Of The Spectroscopic Cavity [3, 8].However, Measurements Of Hyperspectal Irradiance Performed By Morel Et Al. Indicates That UV Absorption (350 To 400) Is Lower Than That Determined By Other Researchers [4].A Proposed Configuration Is A Thermal Lens Beam [9] As Recommended By The Technique, And Is Used To Measure The Absorption Spectrum For Pure Water 350-528 Nm; But For The Case Study A Dual-Beam Thermal Lens Configuration Is Used, Which Optimizes The Technique, And Is Used To Measure The Spectrum Absorption Of Pure Water Ranging From 350 To 528nm [10].

II. HARDWARE IMPLEMENTATION

Derived From The Proposal In The Dual-Beam Thermal Lens Configuration, It Is Proposed Here To Use The Configuration Shown In Figure 1, Which Is Intended To Make The Thermal Lens Experiment Portable. As Can Be Seen In Figure 1 We Have A Laser Diode Whose Wavelength Has Been Selected According To The Type Of Sample That Has, Which In This Case We Are Talking About Domestic Water.It Is Important To Point Out That The Proposed Configuration Has The Advantage That Thanks To The Beam Splitter The Light Beam Can Be Refracted Towards The Sample And Reflected Towards A Photo Diode.

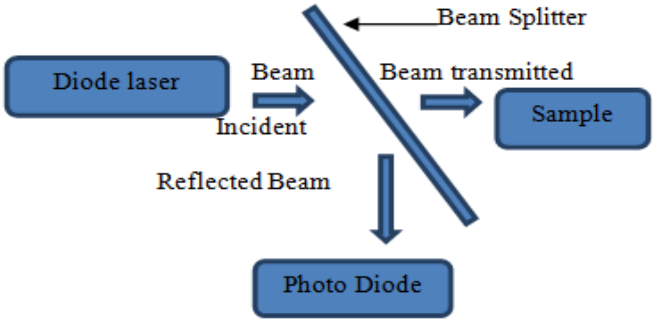

Figure 1. First Phase of The Thermal Lens Experiment

With This We Guarantee To Obtain A Closed Loop To Control The Optical Power Of The Laser Diode, And At The Same Time Apply To The Technique Of Thermal Lens Spectroscopy, Which We Can See Represented By Figure 2

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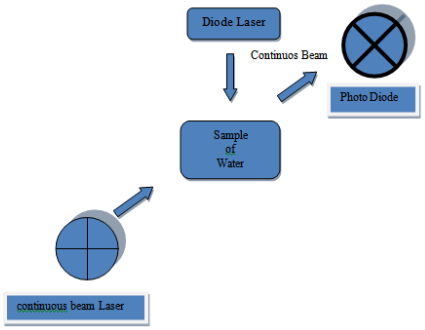

Figure 2. Configuration Of Thermal Lens Spectroscopy For Water

This Technique Allows Modulating The Available Sample, Which For The Case Study We Have Water With A Known Wavelength. In Such A Way That With This Configuration You Can Observe Some Type Of Polluting Species In The Water. For This Work We Will Focus On The Proposed Thermal Lens Spectroscopy Configuration Using Hardware That Allows The Experiment To Be Performed.Using The Driver Of Figure 3, We Can Control The Amplitude Modulation Of The Laser Diode That Will Be Responsible For Generating The Amplitude And Phase Response With Respect To The Frequency, This Response Will Be Delivered Directly By A Look-In Amplifier And The Results Of The System Will Be Fully Functional. It Is Worth Mentioning That Thanks To The Use Of The Driver We Can Discard The Use Of The Chopper Which Is Replaced By That Driver, In Addition To The Chopper Is Part Of A Complex And Expensive Laboratory Specialized In Photothermic Techniques. The Electronic Tool Is Simple Only Making Use Of 2n2222a Bipolar Transistor With A Resistance Of 1KΩ, It Allows The Laser Diode To Use The Necessary Charge Current.

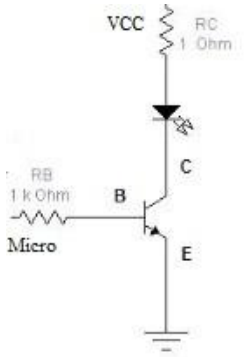

Figure 3. Driver To Modulate According To The Simple Amplitude

The Driver Also Is Part Of An Electronic Card, See Figure 4 Which Is Responsible For The Control Of The Modulation Of The Laser Diode.

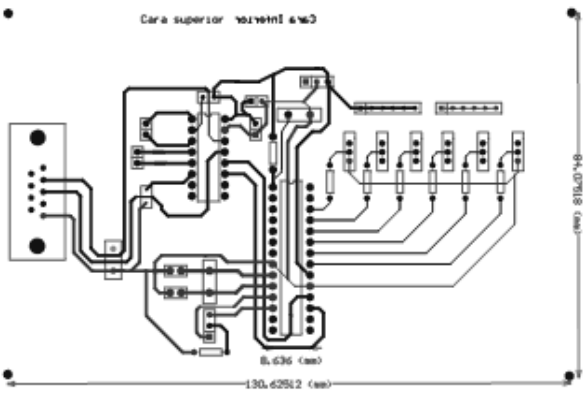

Figure 4. Phenolic Plate For Modulation Control

The Design Of The Electronic Card For The Control Of The Modulation Has As Main Element One Microcontroller Of The Microchip Family The PIC16F876, Which Has A Code That Allows Us To Select And Control The Modulation Of The Laser Diode That Will Apply To Determine According To The Sample The Coefficient Of Absorption Of The Sample.

The Diagram Shown In Figure 5 Shows The Operating Function Of The Control Board.

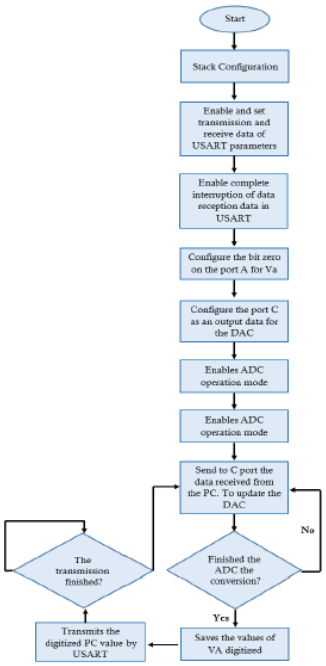

Figure 5. Diagram Of Operation Of The Control Card

III. RESULTS

Figure 6 Shows The Stability Of The Electronic Tool, Which Is The Case Of The Driver, Which, When Controlled By The Card, Modulates In Amplitude Thanks To The TTL Signal Received By The Base Of The Transistor 2n2222a.

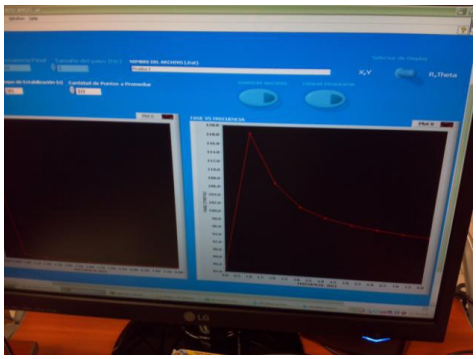

Figure 6. Response In Amplitude And Phase With Respect To Frequency

Thanks To The 1KΩ Resistance At The Base Of The Transistor, The Laser Diode Consumes The Current Necessary To Operate Properly. As A Result Of The Operation Of The Electronic Tool In The Figure 6 Is Shown The Amplitude And Phase Response With Respect To The Frequency Variation Of The Modulation On The Water Sample.

IV. CONCLUSION

Finally, The Use Of Electronic Circuits Allows The Modulation Control Of A Set Of Laser Diodes Which Have A Direct Application To The Thermal Lens Experiment For Spectroscopic Detection, In Addition To Perform The In-Situ And In-Vivo Experiment For The Determination Of The Coefficient Of Water Absorption.

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