MATERIAL SCIENCE AND TECHNOLOGY .I

FT-IR
(Fourier Transform Infrared Spectroscopy)

- O.Aykut KÖKEN

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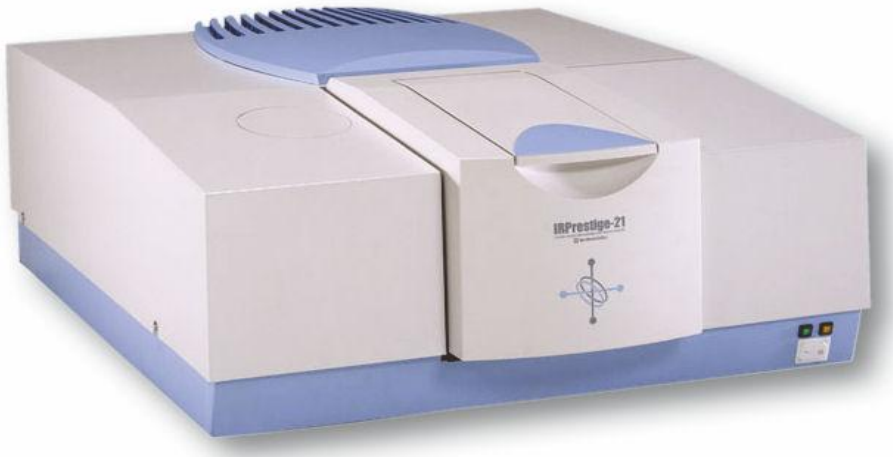


INTRODUCTION

* History of FT-IR
* How does it work ?
* Parts of FT-IR
* Advantages
* Materials & Industrial Areas of FT-IR

Goals Of Our Presentation

* What is the FT-IR ?
* Explaining working principle of FT-IR
* Providing information about the application areas of FT-IR.

History of FT-IR

Albert Abraham Michelson ;

- Devised Michelson interforemeter with Edward Morley in 1880.

Albert Abraham Michelson
(1852-1931)

History of FT-IR

He ;

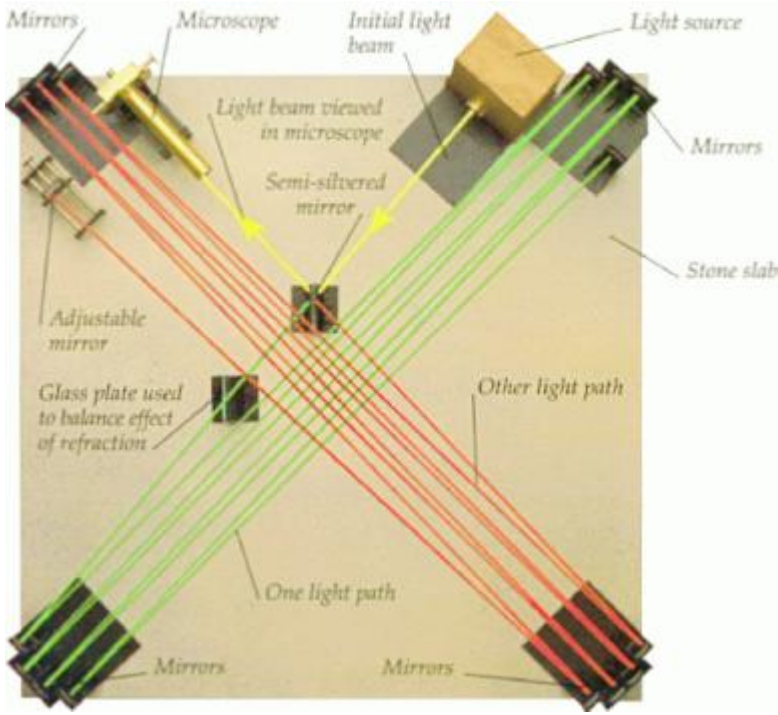
- detects the motion of the earth through the ether

  * There was no!

  * Death knell for the ether theory

- No detector was available
- Nonexistence of Fourier Transform algorithms cabaple of being performed by human calculators.

- Rubens and Wood presented the first real interferogram in 1911.



How does it work ?

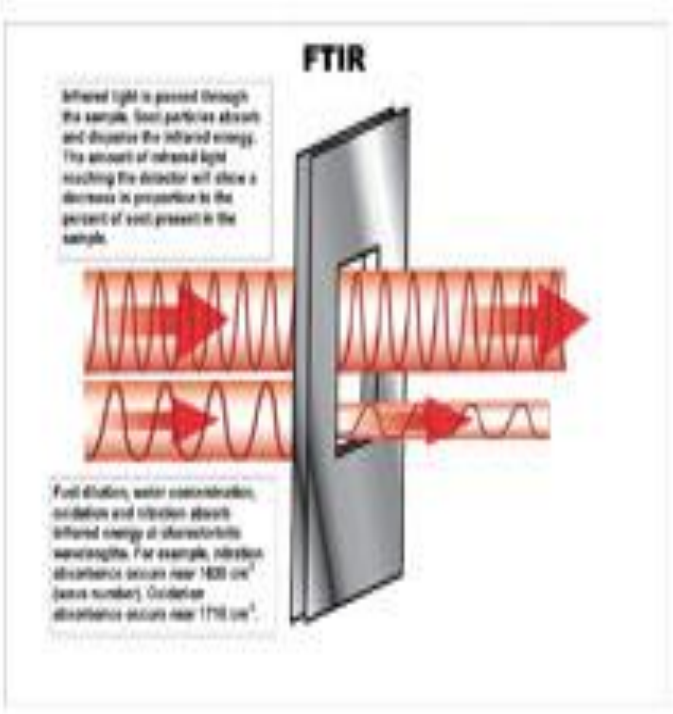
* Fourier Transform Infrared Spectroscopy (FT-IR) provides specific information about chemical bonding and molecular structures, making it useful for analyzing organic materials and certain inorganic materials. Chemical bonds vibrate at characteristic frequencies, and when exposed to infrared radiation, they absorb the radiation at frequencies that match their vibration modes. Measuring the radiation absorption as a function of frequency produces a spectrum that can be used to identify functional groups and compounds.

Principle of Operation

- A beam of infrared light (wavelength ~ 0.7-500 μm)
- Different wavelengths.
- every organic compound (except optical isomers) and many inorganics.
- qualitative analysis.
- quantitative analysis.

Why is FT-IR ?

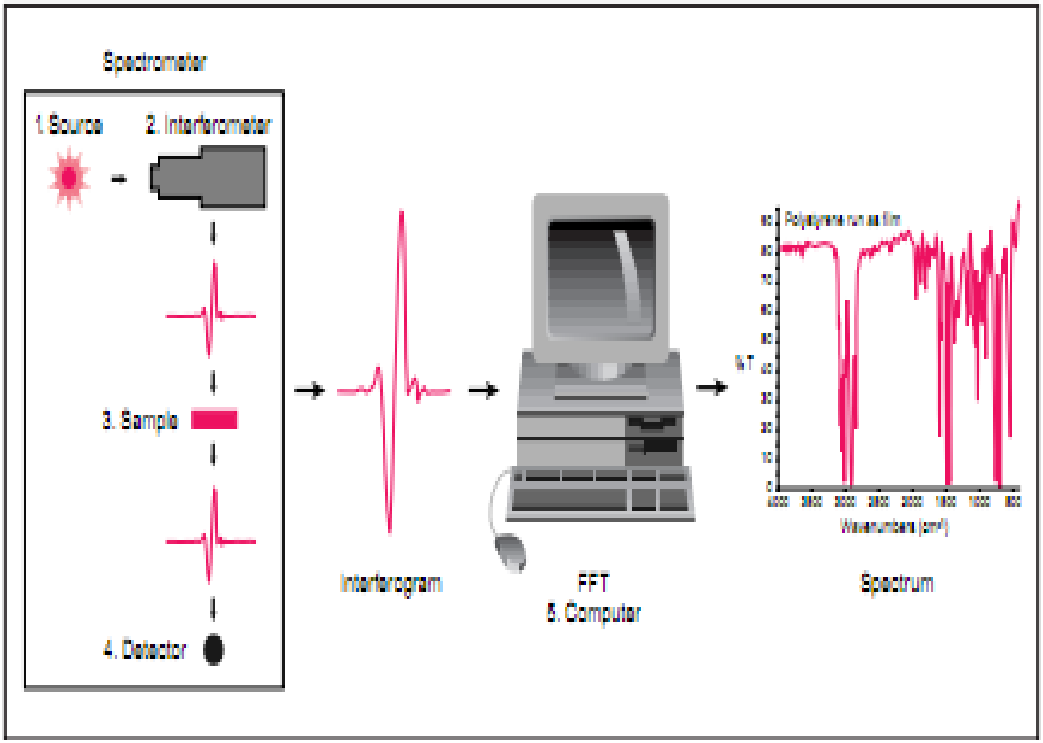
- It is a non-destructive technique
- It provides a precise measurement method which requires no external calibration
- It can increase speed, collecting a scan every second
- It can increase sensitivity – one second scans can be co-added together to ratio out random noise
- It has greater optical throughput
- It is mechanically simple with only one moving part



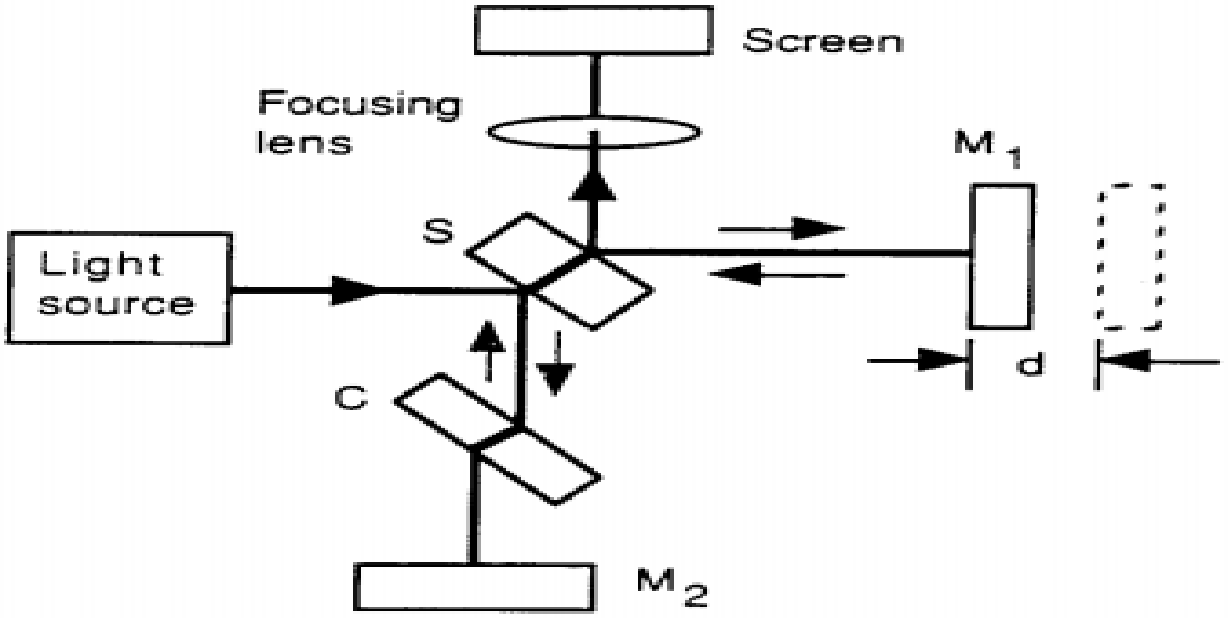
The Sample Analysis Process

The normal instrumental process is as follows :

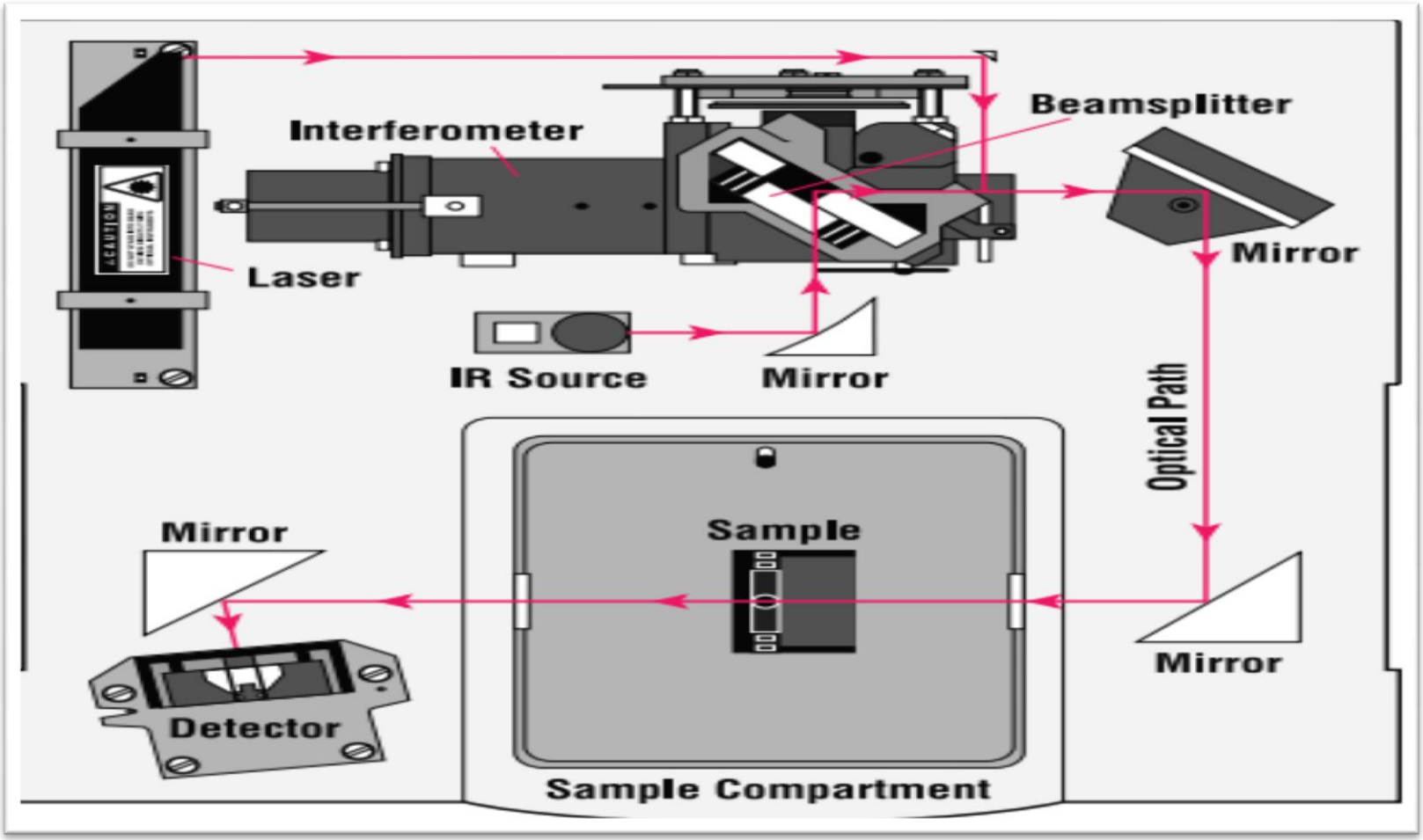
- The Source
- The Interferometer
- The Sample
- The Detector
- The Computer



Michelson Interferometer



A simple spectrometer Layout ;



FT-IR Applications Include

* Materials Evaluation
* Failure Analysis
* Quality control screening

Materials Evaluation

Identification of;

* most solid, liquid and gas-phase organic compounds.
* many liquid and gas-phase inorganic compounds.
* many crystalline and amorphous solid inorganics.
* polymers, polymer blends and multilayer laminates.

Failure Analysis

* Qualitative composition verification.
* Quantitative composition verification.
* Coating composition and thickness measurement.
* Verification of parts cleanliness.
* Solvent purity evaluation.
* Optical filter performance verification.

Quality control screening

* Identification of organic deposits on microelectronic packages and devices.
* Identification of stains.
* Analysis of inclusions in polymers.
* Analysis of delamination problems in laminates and coatings.
* Analysis of surface degradation due to heat, aging, or chemical attack.
* Analysis of process material degradation or contamination.
* Analysis of lubricants, coolants, power transfer fluids and greases for degradation or contamination

Advantages

* Speed → Felgett Advantage
* Sensivity → Jacquinot Advantage
* Mechanical Simplicity
* Internally Calibrated → Connes Advantage

Relavant Industries for FT-IR Analysis

* Aerospace
* Automotive
* Biomedical/biotechnology
* Compound Semiconductor
* Data Storage
* Defense
* Displays
* Electronics
* Industrial Products
* Lighting
* Pharmaceutical
* Photonics
* Polymer
* Semiconductor
* Solar Photovoltaics
* Telecommunications

SUMMARY

Ideal uses for FTIR Analysis ;

* Identifying the molecular structure of organic compounds for contamination analysis
* Identification of organic particles, powders, films, and liquids (material identification)
* Contamination analysis (extracts, outgassed products, residues)
* FT-IR has been some advantages.These are ; speed,sensivity,mechanical simplicity,internally calibrated.

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