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# Neu INSIGHTS



# Stone Analysis

Serial number : 011 Edition : 1. 2022

# Introduction

- ▶ Nephrolithiasis is a common disease, occurring in both industrialized and developing countries and mainly affecting adults aged 20–60 years
- ▶ Stone formation is the end result of a multistep process in which the balance of factors that promote crystallization of urinary salts and factors that inhibit crystallization is perturbed.
- ▶ Urinary stones may be composed of calcium oxalate monohydrate (COM, whewellite), calcium oxalate dihydrate (COD, weddellite), carbonate apatite (CA, dahllite), ammonium urate, magnesium ammonium phosphate (PAM, Struvite), calcium hydrogen phosphate dihydrate (brushite), uric acid (AUO anhydrous form and AU<sub>2</sub> dihydrate form, uricite) and its salts, cystine, xanthine, 2,8-dihydroxyadenine, and drugs.

## Why to analyse stone?

To assist with identification of risk factors.

01

Stone analysis complements, but does not replace, blood and urine analysis in overall metabolic assessment of the stone former.

It may be viewed as a 'biochemical biopsy' so allows identification of risk factors.

02

03

The finding of a stone constituent such as cystine points to a specific diagnosis.

04

The multifactorial nature often associated with the pathogenesis of these types of stones requires further investigation to give specific information on which to base treatment.

# Why FTIR (Fourier Transform Infrared Spectroscopy) method for stone analysis?

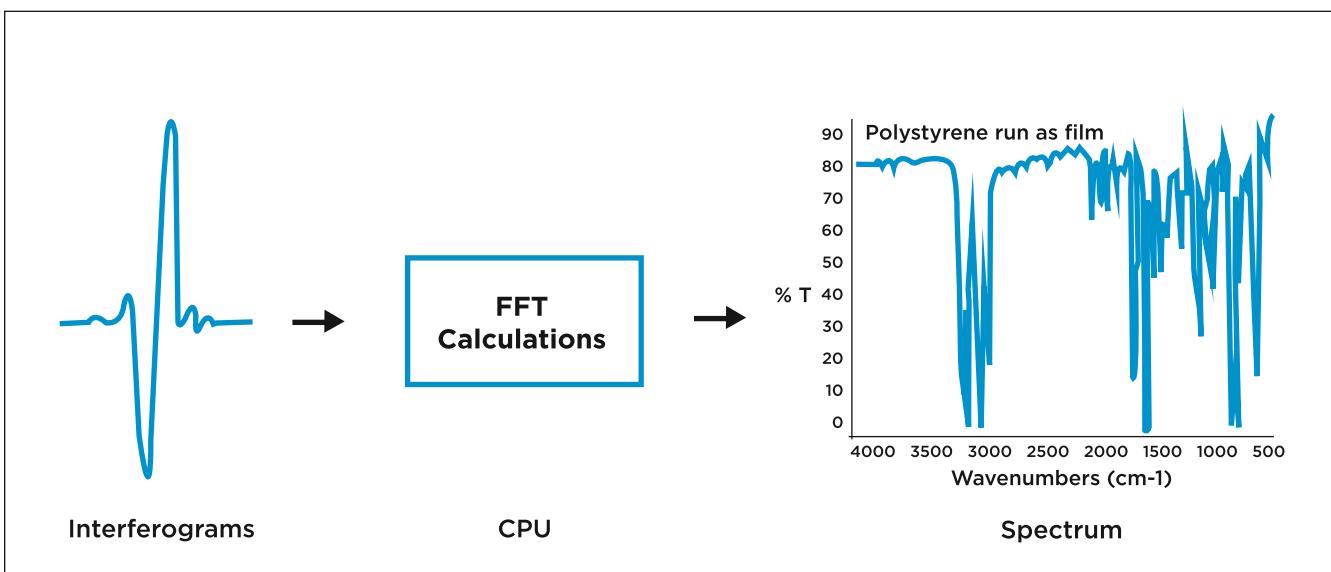
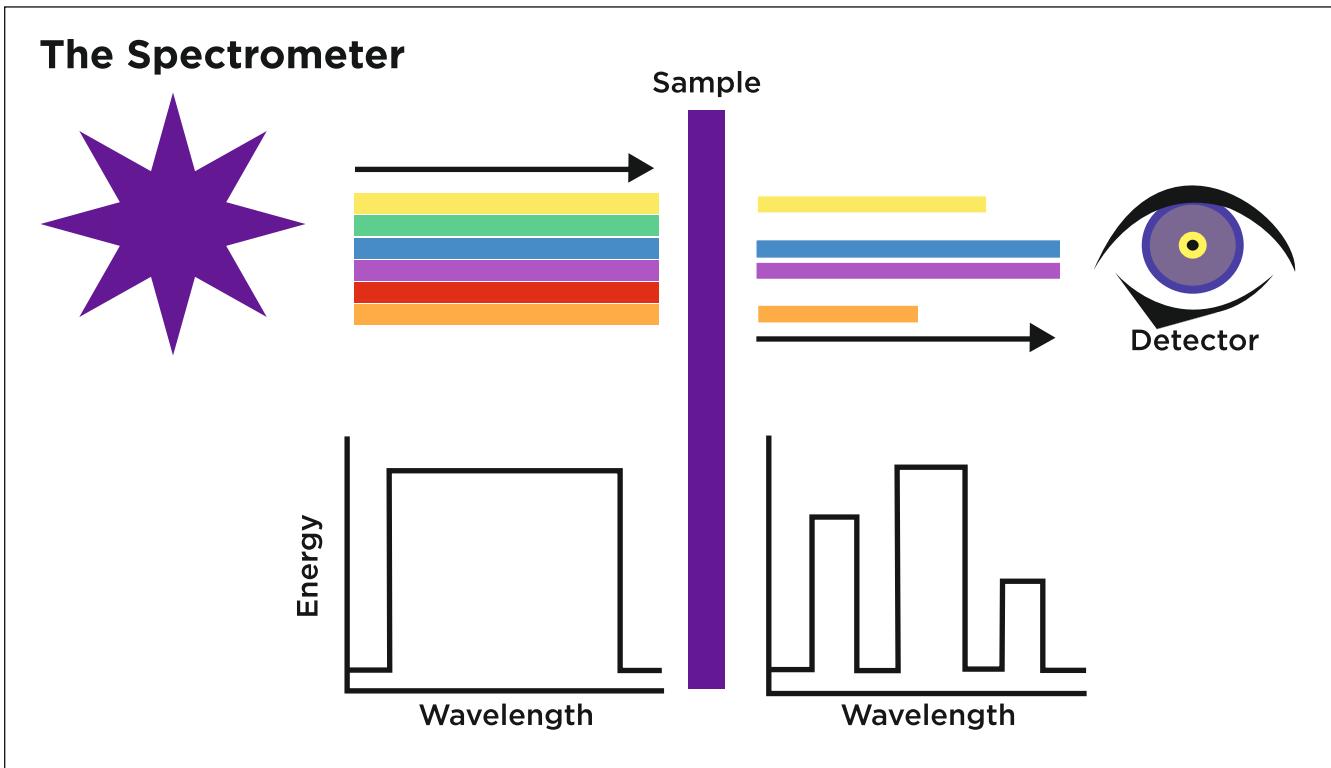
Chemical spot tests are relatively inaccurate because of false-positive and false-negative results and do not allow distinguishing between the crystalline phases. Among physical methods, X-ray diffraction is appropriate for quantification of mineral samples, but it cannot adequately detect amorphous species such as carbapatite or struvite. FT-IR spectroscopy is the most appropriate technique for stones analysis and is becoming the gold standard for stone analysis .

Technique	Advantages	disadvantages
Fourier transform infrared spectroscopy	<ul style="list-style-type: none"><li>► High sensitivity - can examine small amount of sample</li><li>► Fast result</li><li>► Cost effective</li><li>► Does not need highly qualified technician</li><li>► Semiautomatic evaluation and able to identify organic components or noncrystalline substances</li><li>► Can also recognize even small fractions of multiple components as percentage more precisely and accurately as compared to other techniques</li></ul>	<ul style="list-style-type: none"><li>► Lengthy and time-consuming preparation</li><li>► Because of overlapping absorption bands, sometimes there is difficulty in detection of small amounts of components in some complex stone</li></ul>
Chemical analysis	<ul style="list-style-type: none"><li>► Cost- effective</li><li>► Simple to perform</li></ul>	<ul style="list-style-type: none"><li>► Needs large sample size</li><li>► Time taking</li><li>► Gives information about individual ions and radicals rather than a specific compound</li><li>► Cannot detect amorphous or noncrystalline components</li><li>► Costly</li></ul>
X-ray diffraction	<ul style="list-style-type: none"><li>► Analysis is quantitative</li><li>► Can be applied on small sample size</li><li>► Measurement is automatic</li><li>► Easy</li><li>► Exact differentiation of all crystalline components is possible</li></ul>	<ul style="list-style-type: none"><li>► Cannot detect amorphous or noncrystalline components</li><li>► Costly</li></ul>
Scanning electron microscopy	<ul style="list-style-type: none"><li>► Possibility to visualize the components, their shape, internal structure, location inside the stone, and relation between the crystals and the organic matrix</li></ul>	<ul style="list-style-type: none"><li>► Costly</li><li>► Needs qualified technicians</li></ul>
Thermogravimetry	<ul style="list-style-type: none"><li>► Simple</li><li>► Fast</li></ul>	<ul style="list-style-type: none"><li>► Closely related compounds are difficult to differentiate</li><li>► Needs large amount of sample</li></ul>

## How FTIR works?

In infrared spectroscopy, IR radiation is passed through a sample. Some of the infrared radiation is absorbed by the sample and some of it is passed through (transmitted). The resulting spectrum represents the molecular absorption and transmission, creating a molecular fingerprint of the sample. So, what information can FT-IR provide?

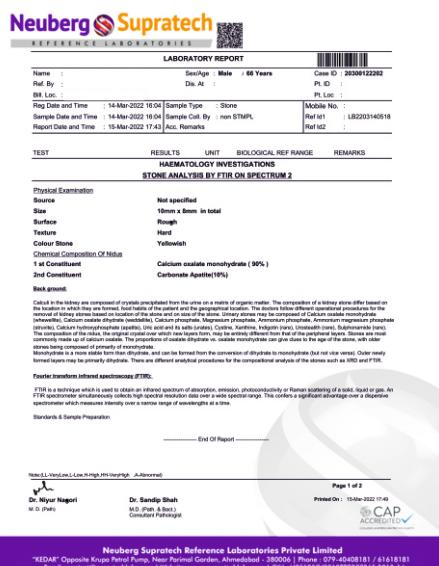
- ▶ It can identify unknown materials
- ▶ It can determine the quality or consistency of a sample
- ▶ It can determine the amount of components in a mixture.



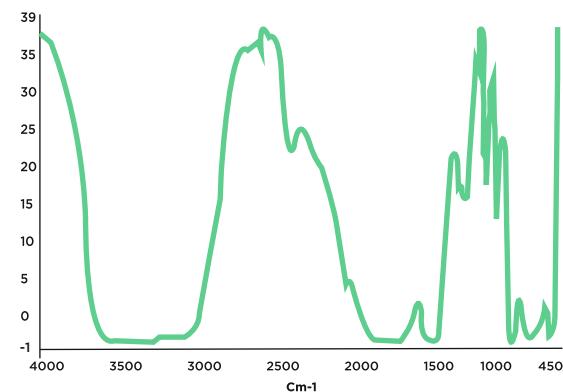
## Spectrum II FTIR from Perkin Elmer



### Report format



### Machine Data



### Single Search Details 2

#### Search Score

0.980351

0.970009

0.957891

0.94699

0.945827

0.945193

0.936806

0.936077

0.931084

0.929126

#### Search Reference

Ks0357

Ks0356

Ks0336

Ks0329

Ks0353

Ks0359

Ks0339

Ks0358

Ks0331

Ks0328

### Search Reference Spectrum Description

0357.SP WHEWELLITE AND WEDDELLITE

0356.SP WHEWELLITE AND WEDDELLITE

0336.SP WHEWELLITE + WEDDELLITE 1:1

0329.SP WHEWELLITE

0353.SP WHEWELLITE AND WEDDELLITE

0359.SP WHEWELLITE SYNTHETIC

0339.SP WHEWELLITE 80 % + AMMONIUM URATE 10% + CARBONATE APATITE 20%

0358.SP WHEWELLITE SYNTHETIC

0331.SP WHEWELLITE

0328.SP WHEWELLITE

### Single Search Details 2

#### Single Search Details 2

#### Search Library

#### Search Library Path

#### Search Library Description



**Sample type:**  
Kidney/Gall Bladder  
stone



**Machine :**  
PerkinElmer's  
Spectrum II



**Method:**  
FTIR (Fourier  
Transformed Infrared  
spectroscopy)



**TAT:**  
Tuesday      Thursday      Saturday

with cut off time 12 noon, reporting same day  
evening by 8 pm.

# PARTNERS IN HEALTH



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