A Career in Analytical Chemistry

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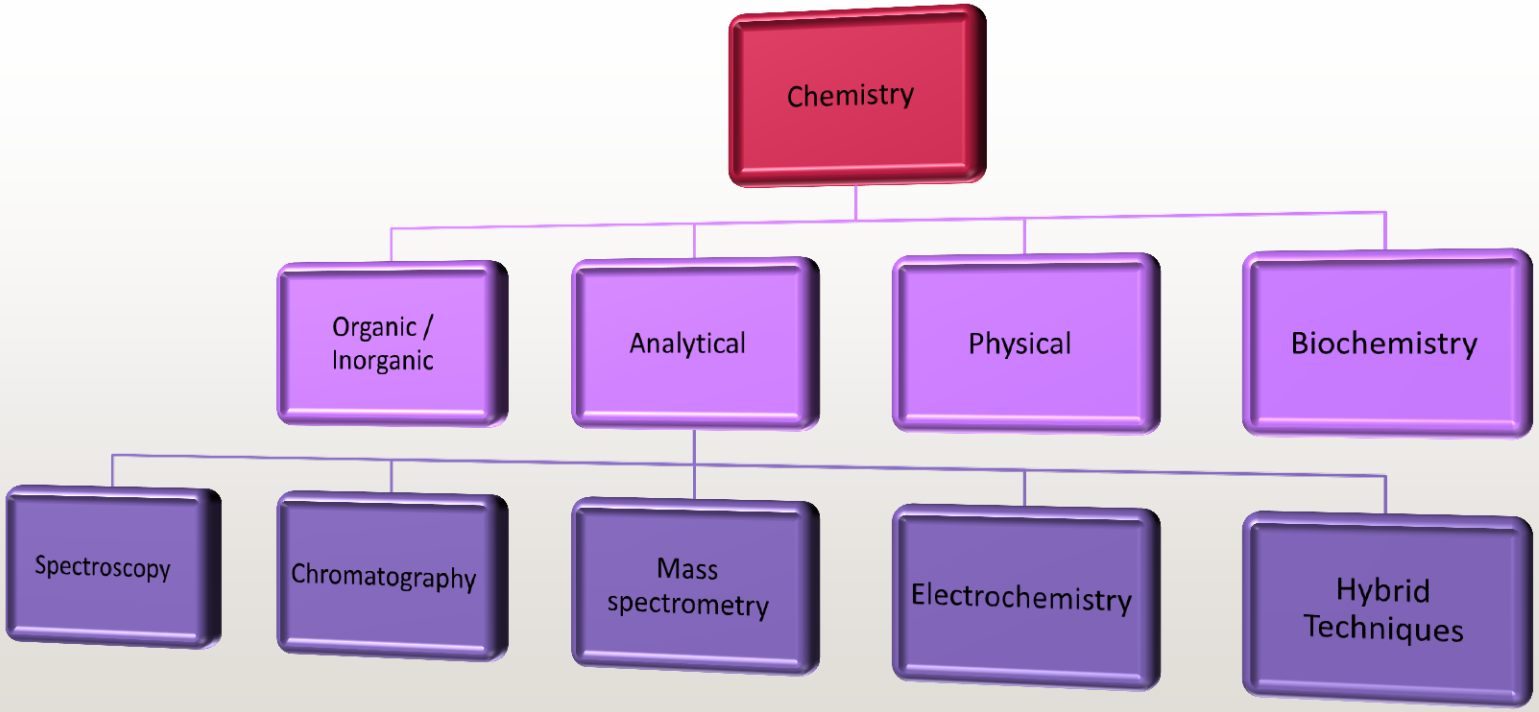
Bite of Science – October 17th , 2016

About Me…

- Originally from SW Pennsylvania
- Shippensburg University
  - Chemistry, Math minor
- University of Cincinnati
  - Analytical Chemistry
  - Chemical Sensors

A Graduate Degree in Chemistry



FDA Forensic Chemistry Center

- Located in Cincinnati, OH
- Specialty field laboratory that supports FDA's Office of Criminal Investigation
- Samples are related criminal investigations
  - Pharmaceutical Counterfeiting
  - Product Tampering
- Analytical techniques: FT-IR, Microscopy, GC-MS

WestRock

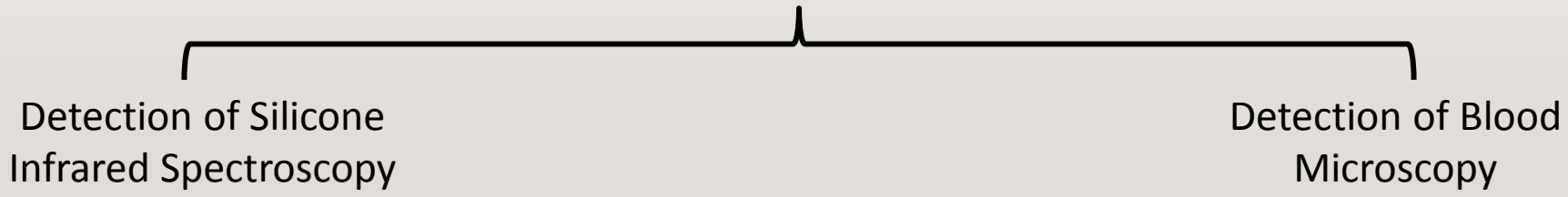
- Headquarters in Norcross, GA, but several locations in Richmond, VA area.
- Provide paper and packaging solutions in consumer and corrugated markets.
  - Research, Development, and Technical Services
    - Fiber Science
    - Material Science
    - Analytical Services
- Analytical Techniques: FT-IR, GC-MS, DSC

Case Report

- Analysis of Hypodermic Needles and Syringes for the Presence of Blood and Polydimethylsiloxane (Silicone) Utilizing Microchemical Tests and Infrared Spectroscopy
  - Journal of Forensic Science, July 2015, Vol. 60, No. 4
  - John B. Crowe, Adam Lanzarotta, Ph.D., Mark R. Witkowski, Ph.D., and Sara E. Andria, Ph.D.

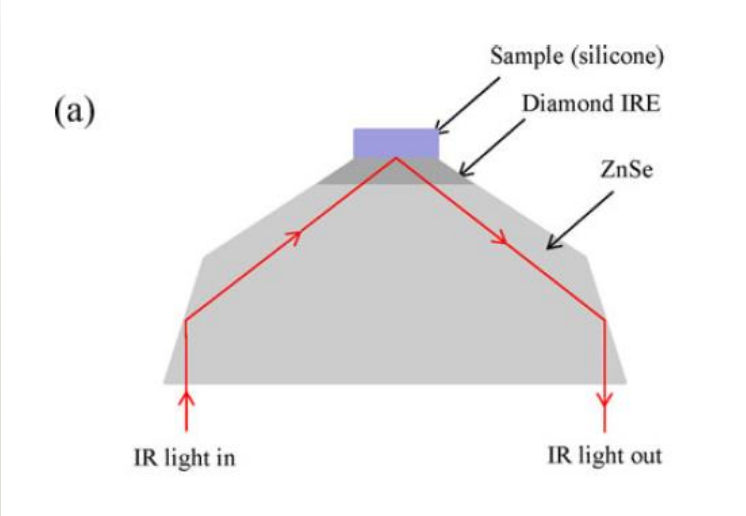
Case Report

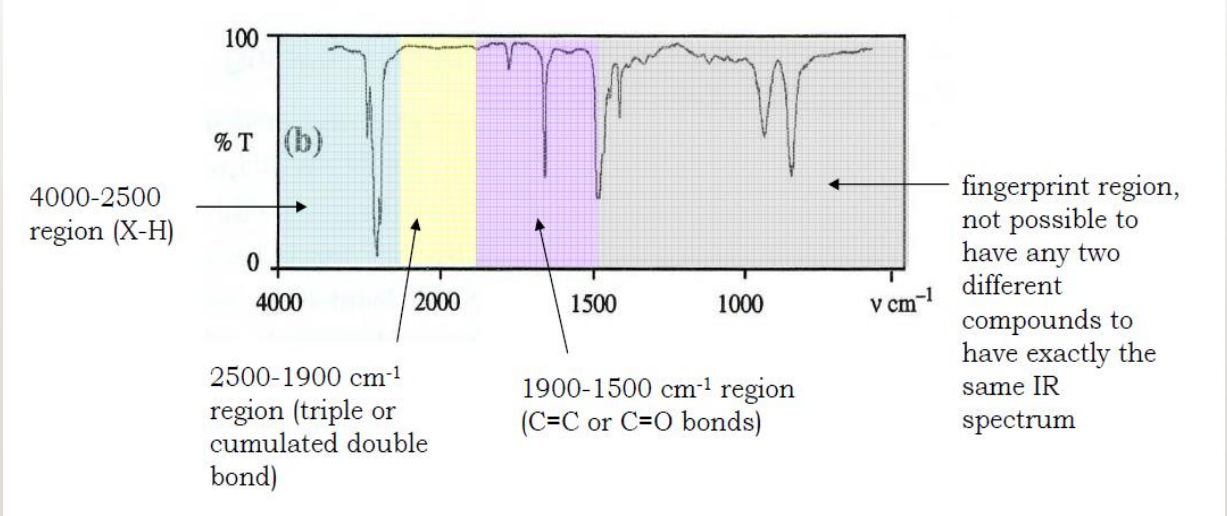
- Background:
  - Joint task force (FBI / FDA-OCI) was informed about a person performing cosmetic enhancements out of her home.
    - Person was not licensed
    - Silicone was not obtained through proper channels
    - Improper disposal of the medical waste
  - Samples received – used syringes and needles



Case Report

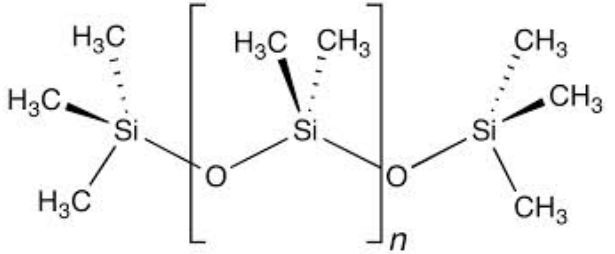
- Infrared Spectroscopy
  - All molecules vibrate – stretching, bending, etc.
  - IR radiation (laser) will be absorbed when there is dipole moment change associated with the vibration (O-H, N-H, C=O, C-H)





Case Report

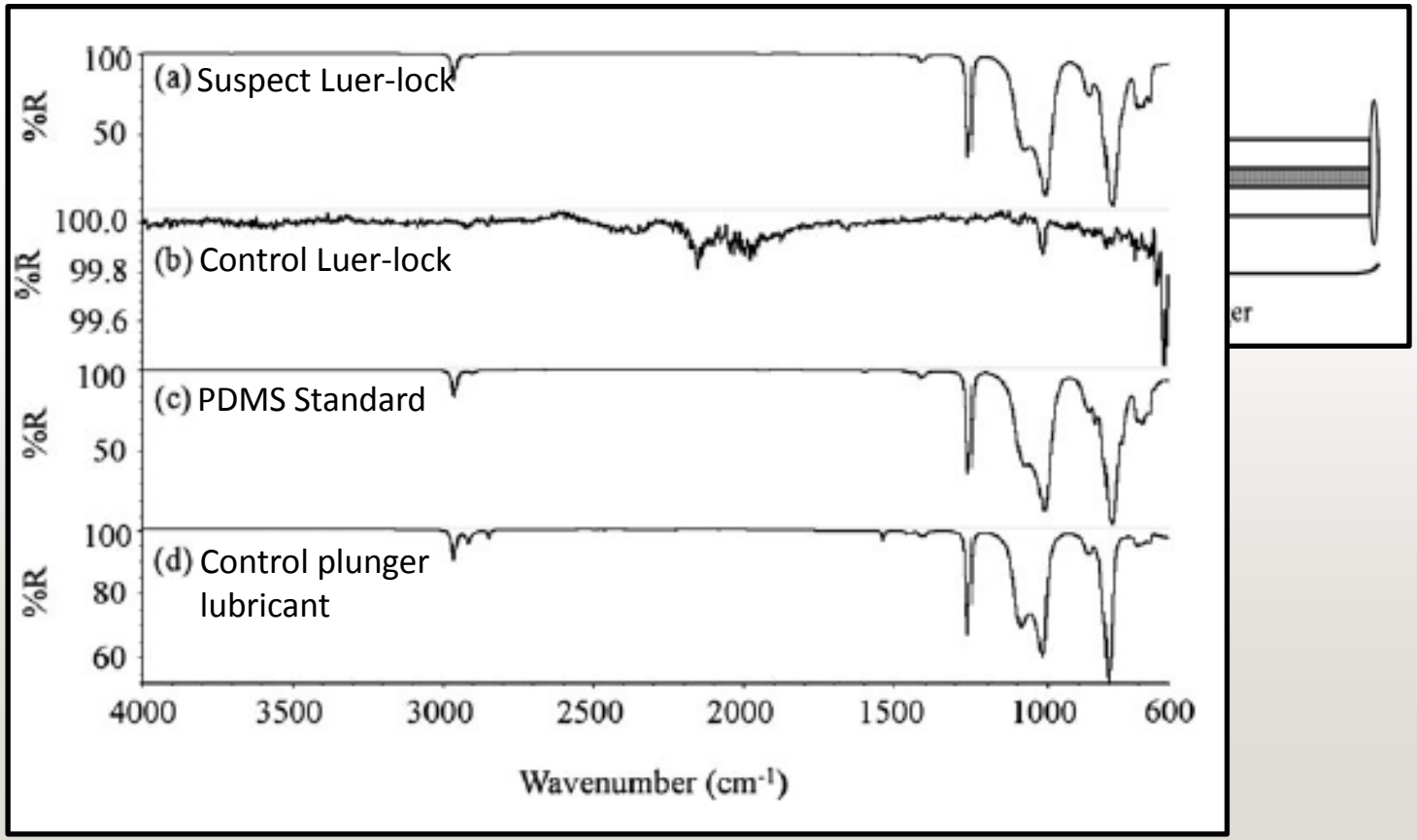
- Polydimethylsiloxane (PDMS) – type of “silicone”
- Good candidate to detect by IR



CH_2 Stretching	Si-C(H_3) Deformation	Si-O-Si Stretching	Si-C(H_3) Rocking
~2960 cm^{-1}	~1260 cm^{-1}	~1020 cm^{-1}	~798 cm^{-1}

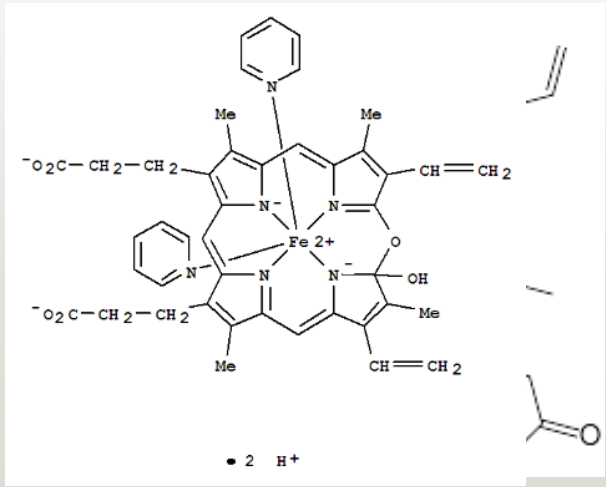
- Challenge: PDMS is also used as a lubricant on the syringes.

Case Report:

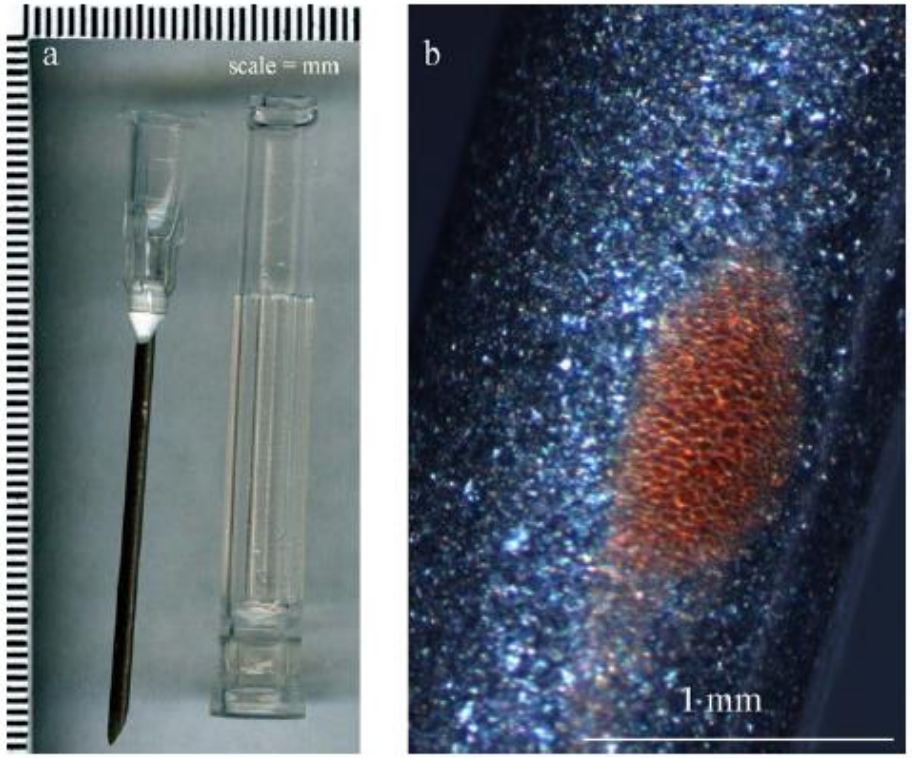

(a) Suspect Luer-lock
(b) Control Luer-lock
(c) PDMS Standard
(d) Control plunger lubricant
%R
100
50
100.0
99.8
99.6
80
60
4000
3500
3000
2500
2000
1500
1000
600
Wavenumber (cm-1)

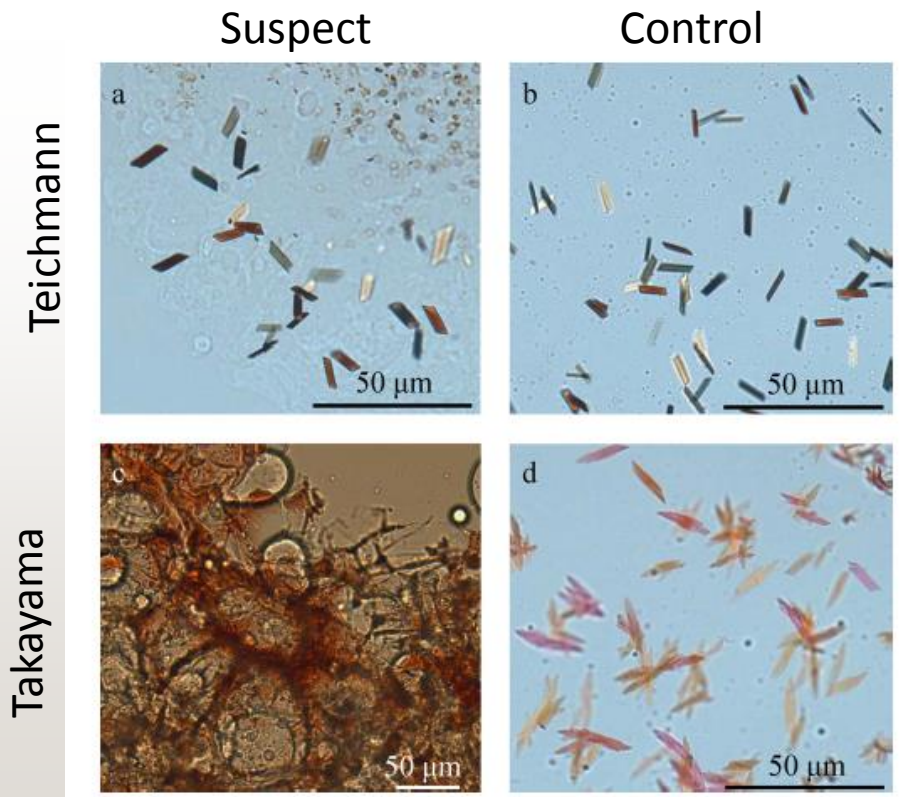
Case Report

- Microchemistry / Microchemical Testing / Chemical Microscopy
  - Using a compound microscope to identify materials based on the results of a chemical test.
  - Technique dates back to the mid-1800's.
- Blood Testing
  - Teichmann Test
    - Hemoglobin + NaOH + Glucose + Pyridine + Heat -> Hemochromogen crystals
  - Takayama Test
    - Hemoglobin + Halide + Acetic acid -> Hemin Crystals



Case Report


a
scale = mm
b
1-mm


Suspect
Control
Teichmann
Takayama
a
50 µm
b
50 µm
c
50 µm
d
50 µm

Case Report

- Results:
  - Successfully distinguished between the PDMS used for the injection and the PDMS used for the syringe lubricant.
  - Showed that the Teichman test can detect for the presence of blood in a PDMS matrix.
  - The suspect plead guilty to one count of injecting an adulterated device, surrendered her proceeds of the procedures, totaling $100,000, to the US government, and was fined for illegally disposing of medical waste.

Microscopy in the Classroom

- Types of Microscopes:
  - Stereoscope vs. Compound
- For Observation:
  - Particles: salt, sugar, borax, epsom salt, alum
  - Fibers: synthetic, natural, hair, paper
  - Any material you can think of…
- For Chemical Reactions:
  - Handout