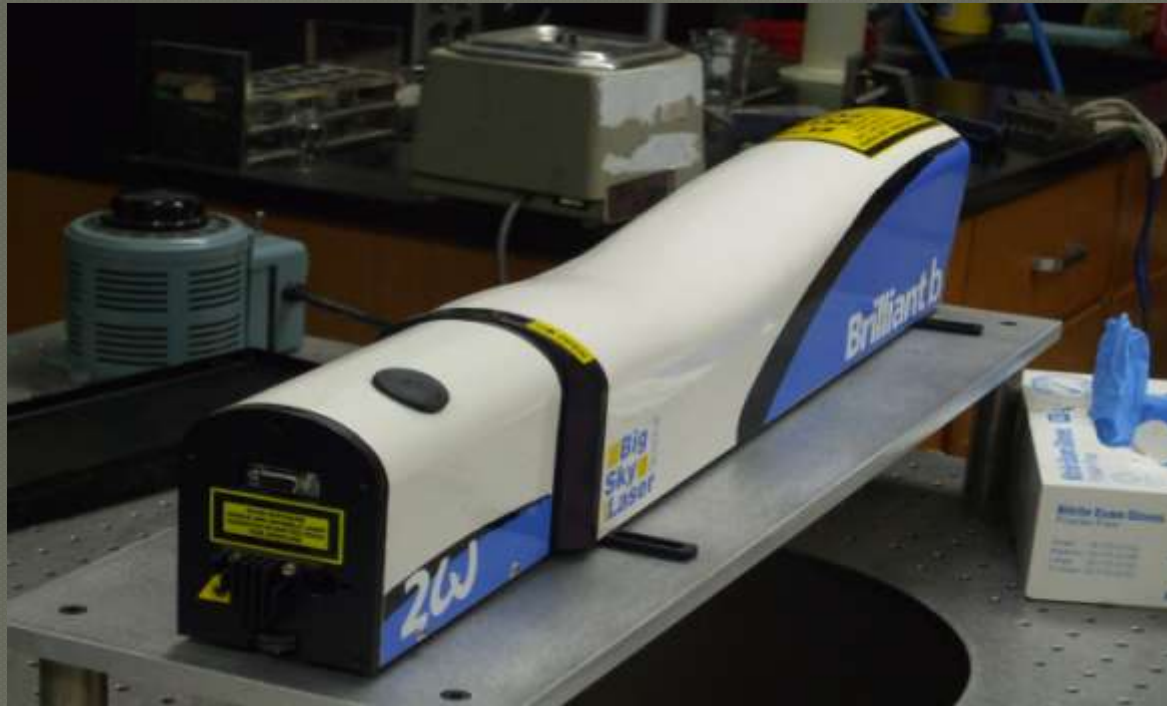


Laser Ablation of Solids in Liquid Environment



Summer 2010

Summer Research Explained

- Pulsed Laser Ablation of solid targets in a liquid environment has proved to be a viable method in creating novel nano-material. Ablation of graphite in an assortment of organic solutions has produced fullerenes both above and below the well known C_{60} fullerene, including for the first time C_{36} . Ablation of graphite submersed in cyclohexane solution along with a small amount of dissolved dihydroanthracene produced the C_{36} fullerene. This, along with the results from the other liquids will be presented.

What is Laser Ablation?

- ◉ A high power laser is used to vaporize the target in an ablation plume.
- ◉ The particles in the plume collide and react with the material that they are submerged in.
- ◉ The conditions of which the target is exposed to is extreme.

Alternative methods

ARC DISCHARGE- APPROX. 30% OF
CARBON FORMS NANOTUBES.

CHEMICAL VAPOR DEPOSITION (CVD)-
APPROX. 100% FORMS NANOTUBES.

So why choose laser ablation?

- Simply because Laser Ablation offers a very versatile means of production, especially when dealing with solutions AND solids as opposed to solids alone.

Structure of a Fullerene

- Fullerenes are cage-like structures made of carbon named after Buckminster Fuller's geodesic domes.



Why are we interested?

- ◉ Graphite has unique electronic properties as well as an enormous tensile strength.
- ◉ The electronic properties alone has already lead to advances in electronics, such as the graphene-enhanced battery.

The Graphite Tip

- The tip is made with graphite powder and a carbon-based glue.
- Mix a suitable ratio in a beaker
- Put in heating manifold for 4-6hrs increasing pressure gradually.



Annealing

- Annealing is a heat treatment that a substance undergoes that causes changes in physical properties. It can be used for a number of reasons including: inducing ductility, softening material, relieving internal stress, or refining the structure to make it homogeneous.



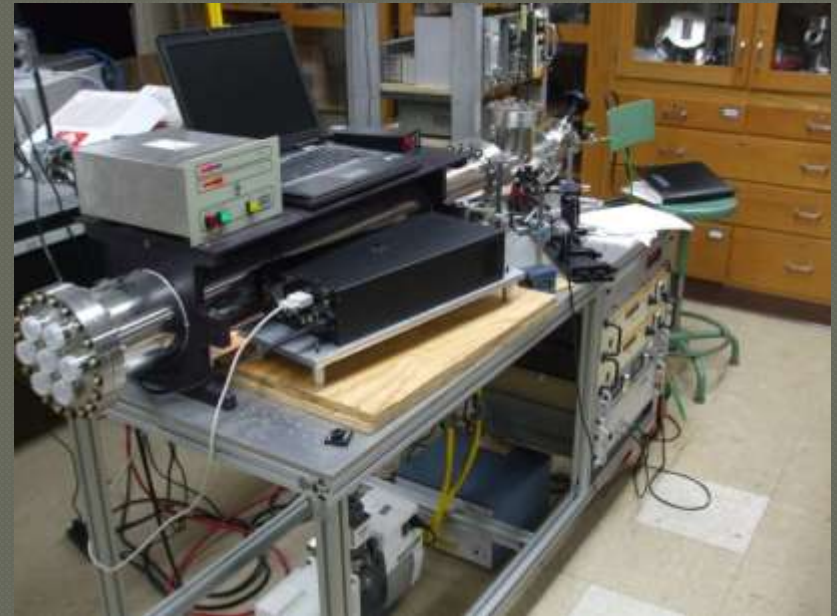
Ablation

- Ablation chamber was filled with argon.
- Solution was bubbled with argon.
- Keep pressure between 300-500 torr.
- Ablate!

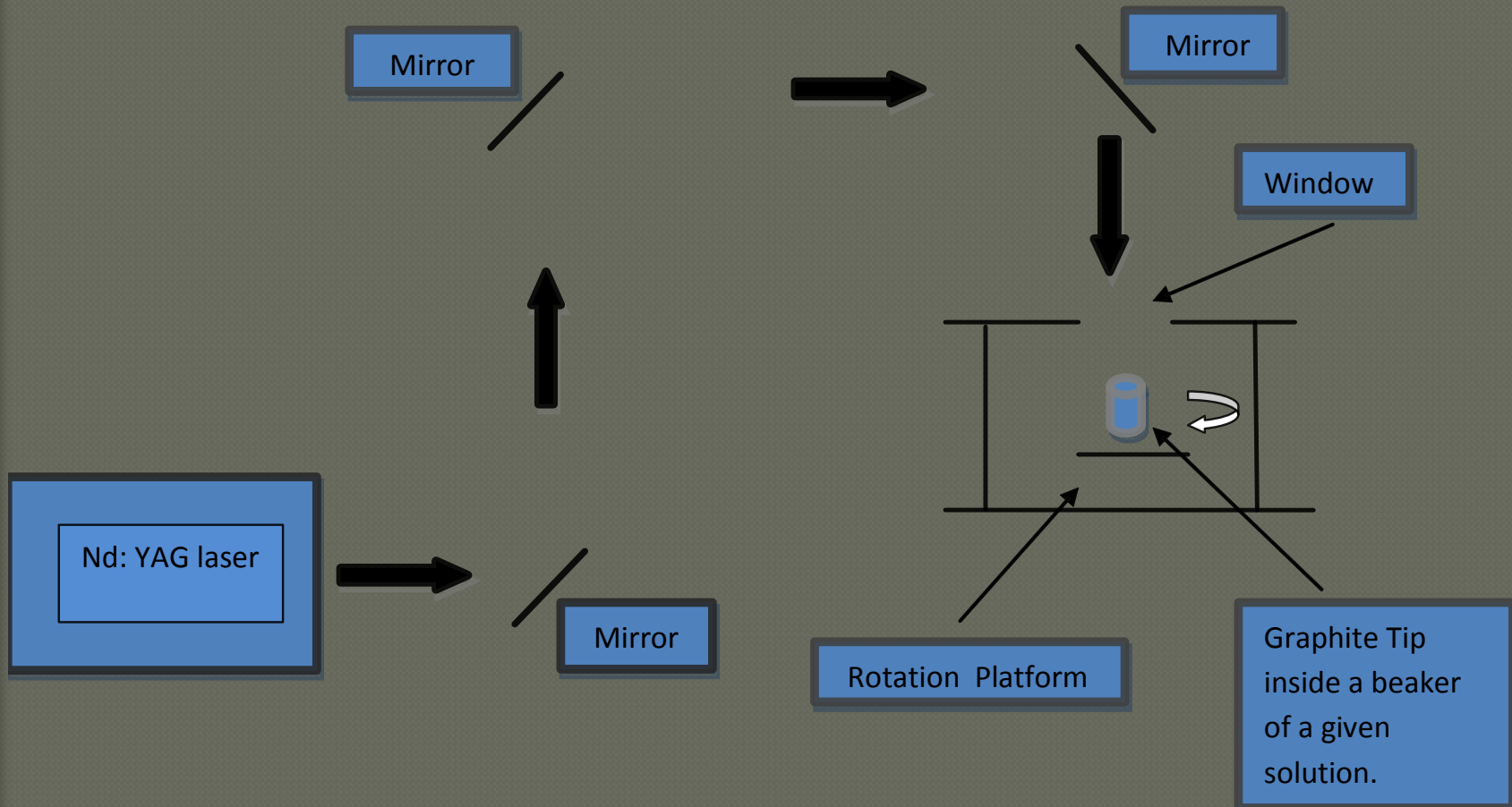


Time of Flight Mass Spec

- This is where the sample was analyzed after ablation.
- Small amount of sample was put on the probe tip.



Schematic Drawing



Solutions used

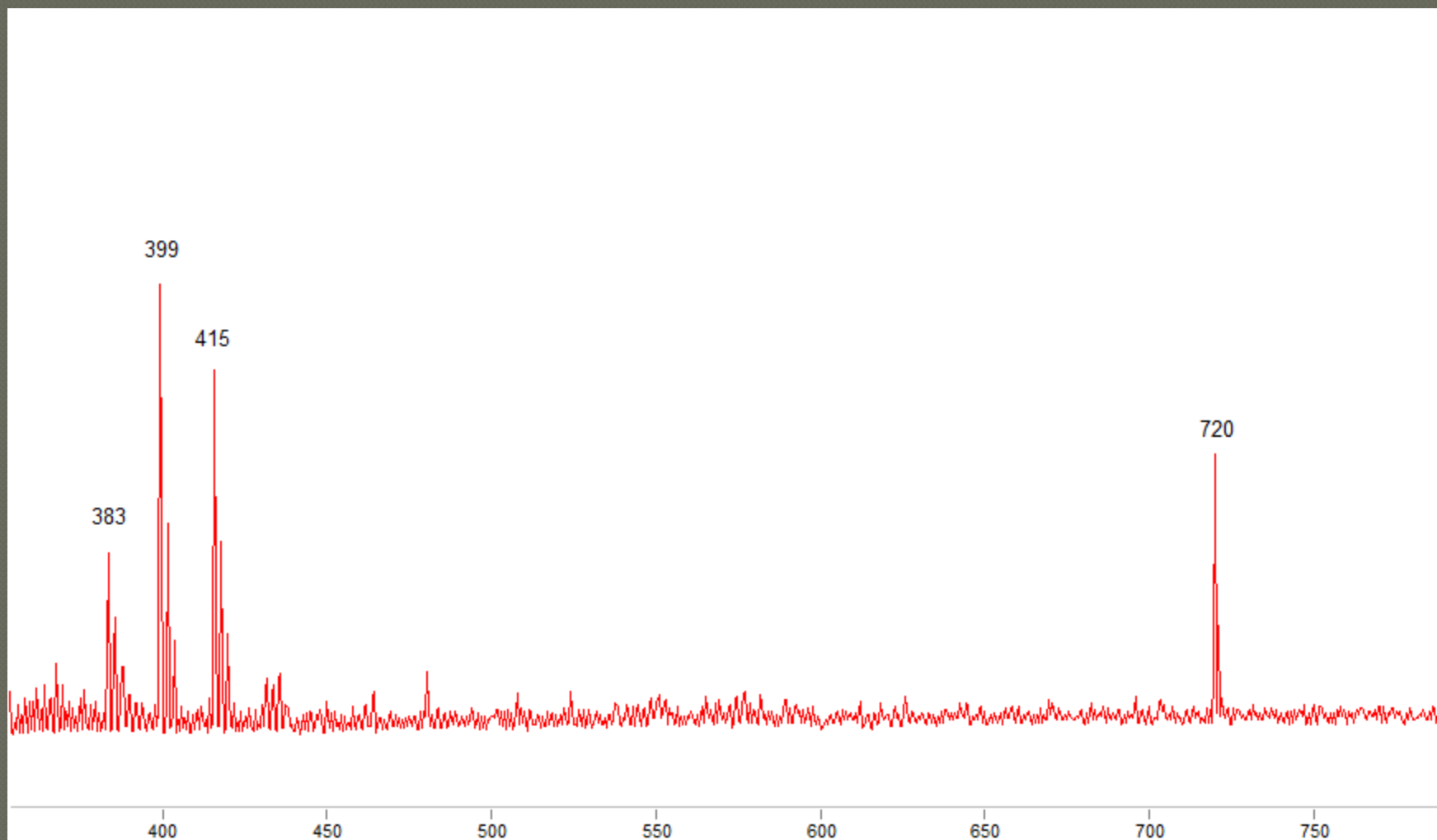
ORGANIC SOLUTIONS

- Cyclohexane
- Pentane
- Toluene
- Ammonia

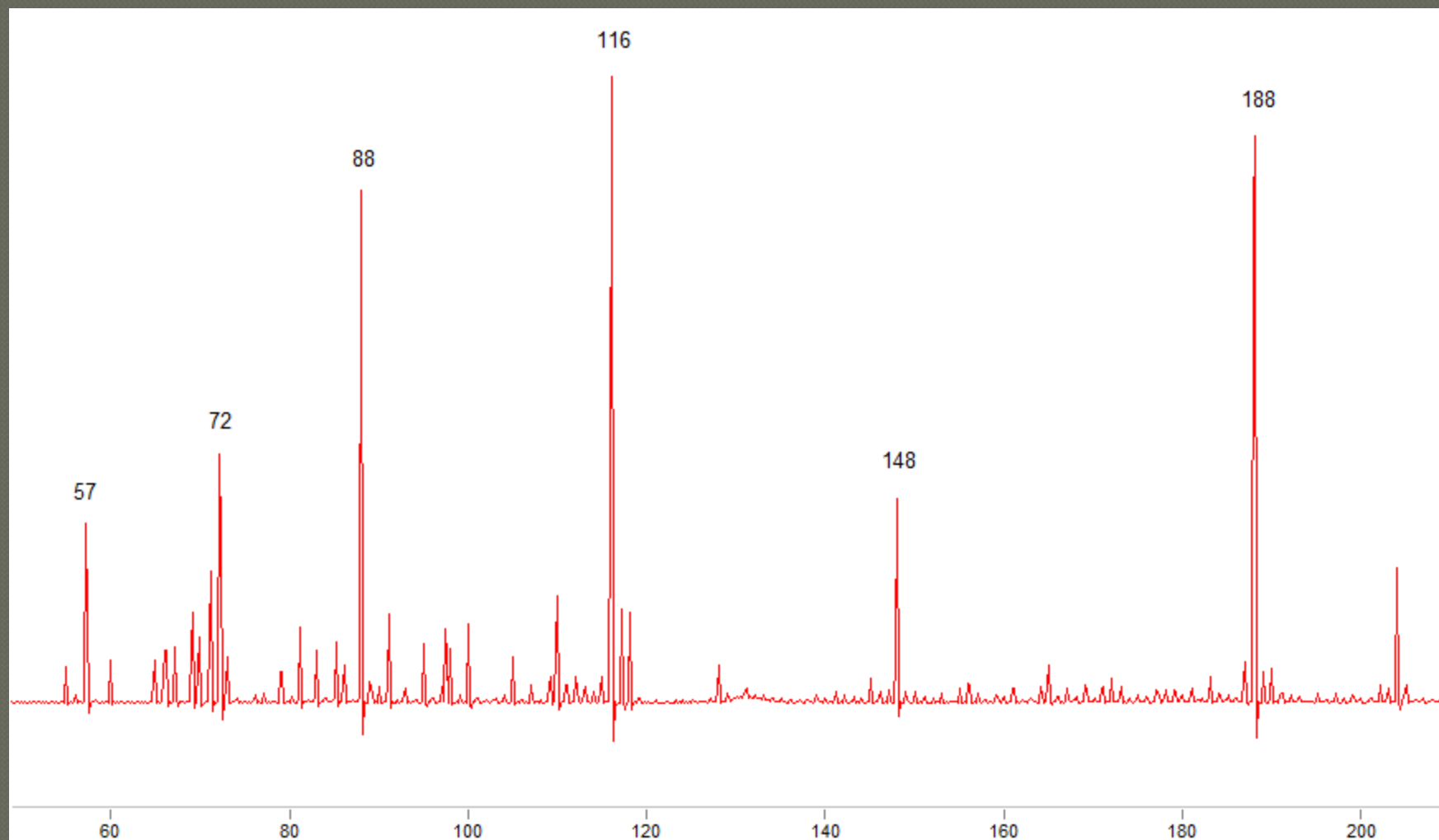
DIHYDROANTHRACENE

- This is a solid substance that was used in the ablation process as a hydrogen source.

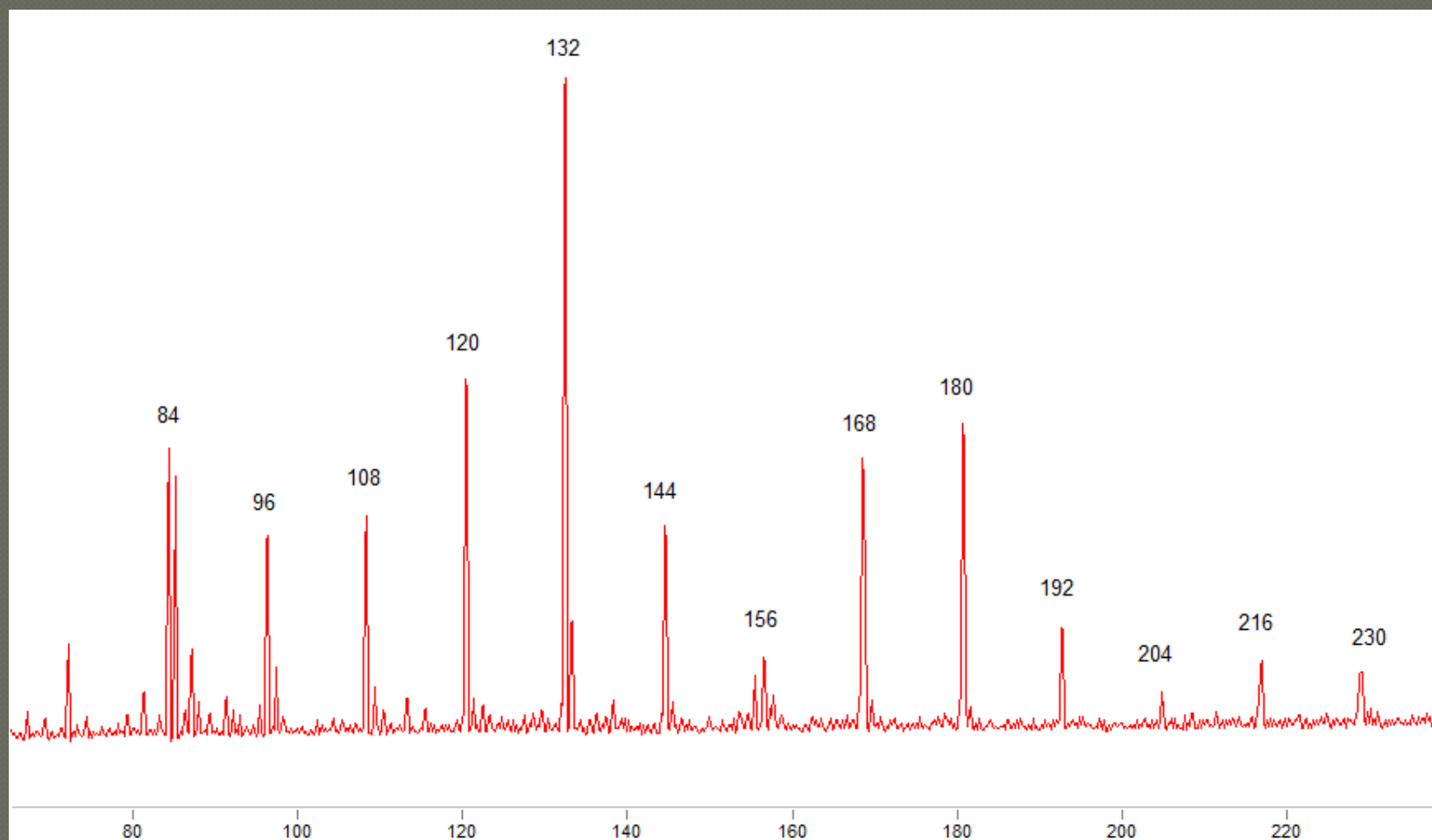
Toluene and Graphite



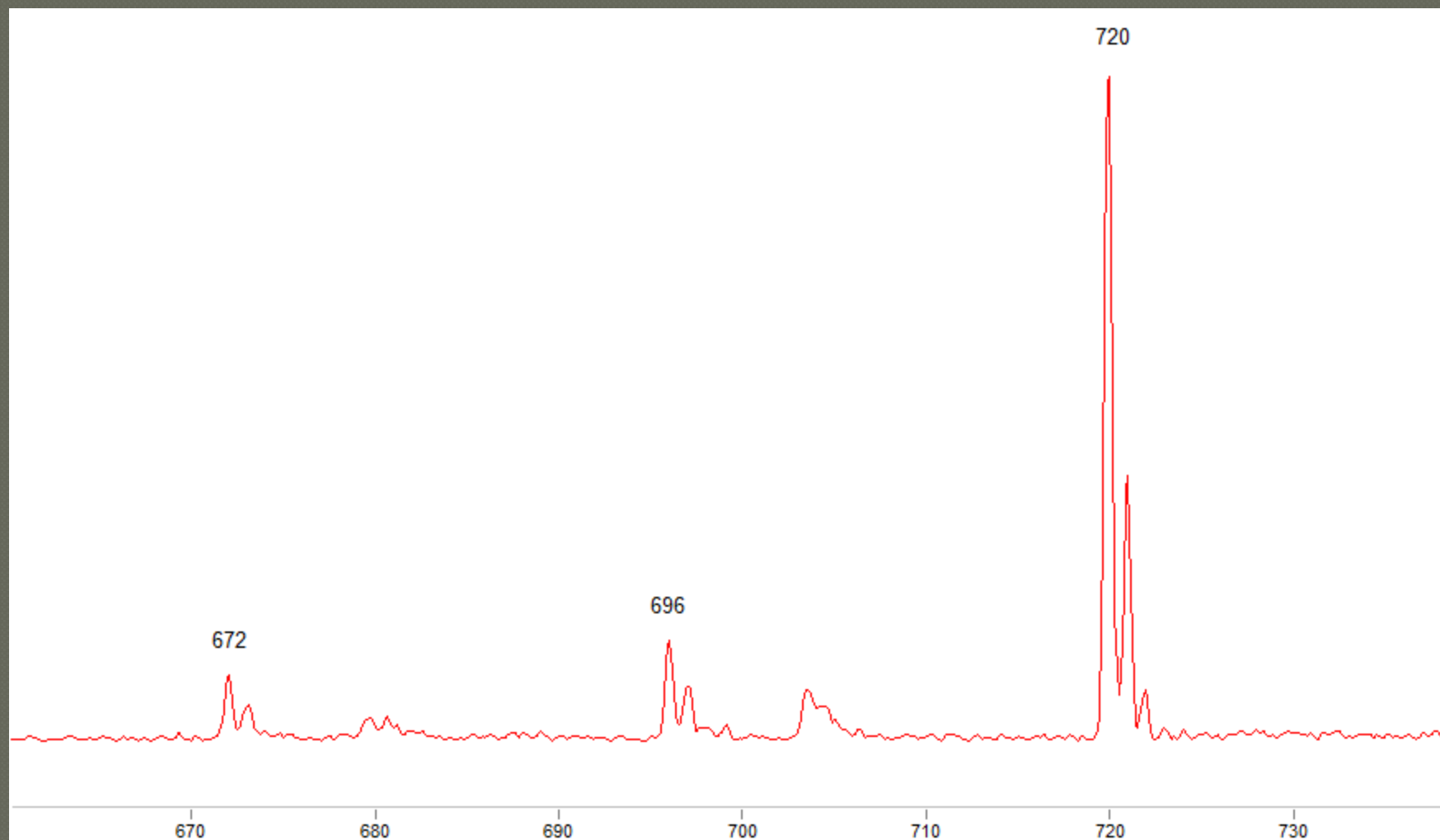
Toluene and Graphite



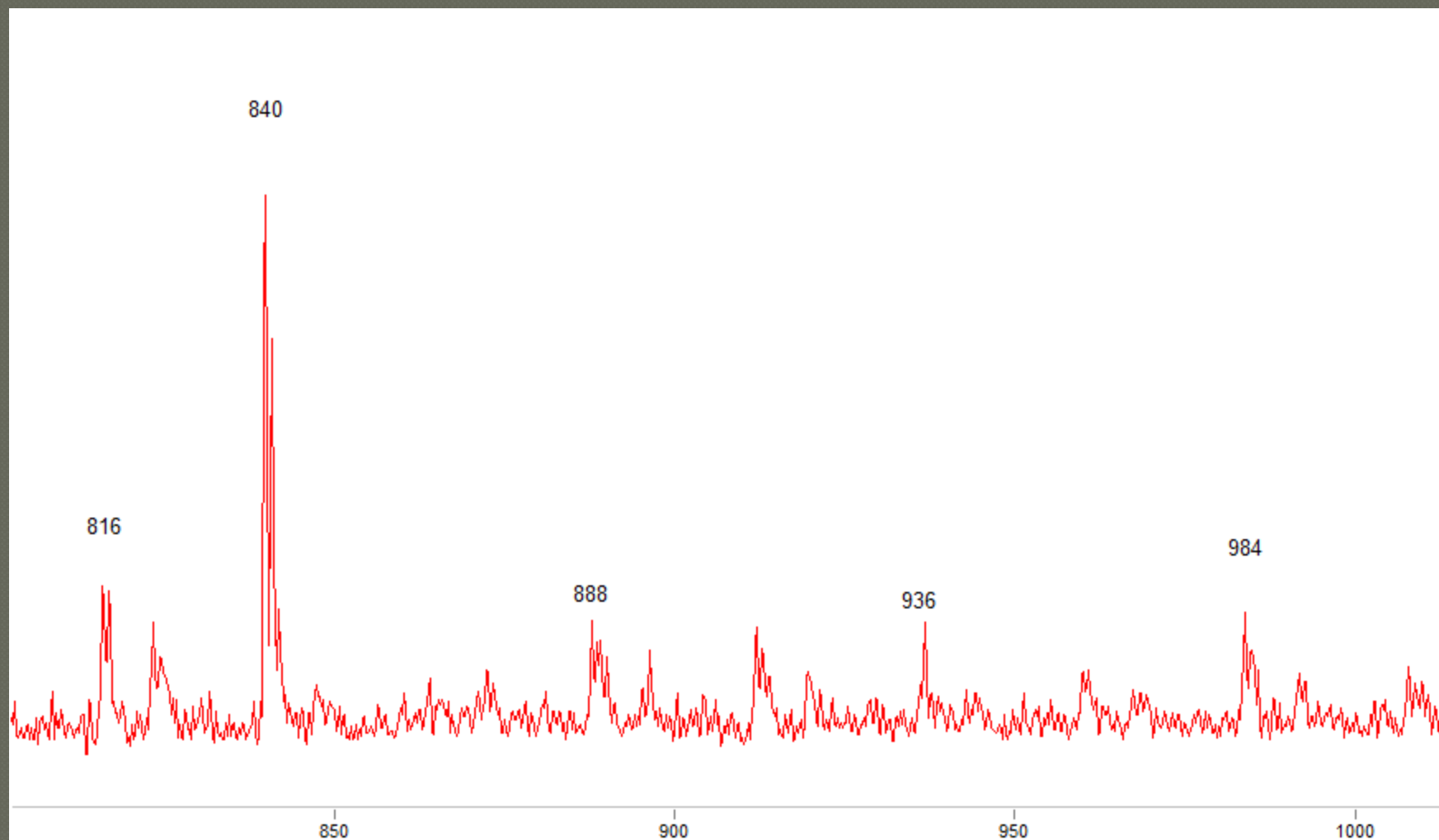
Graphite and Cyclohexane



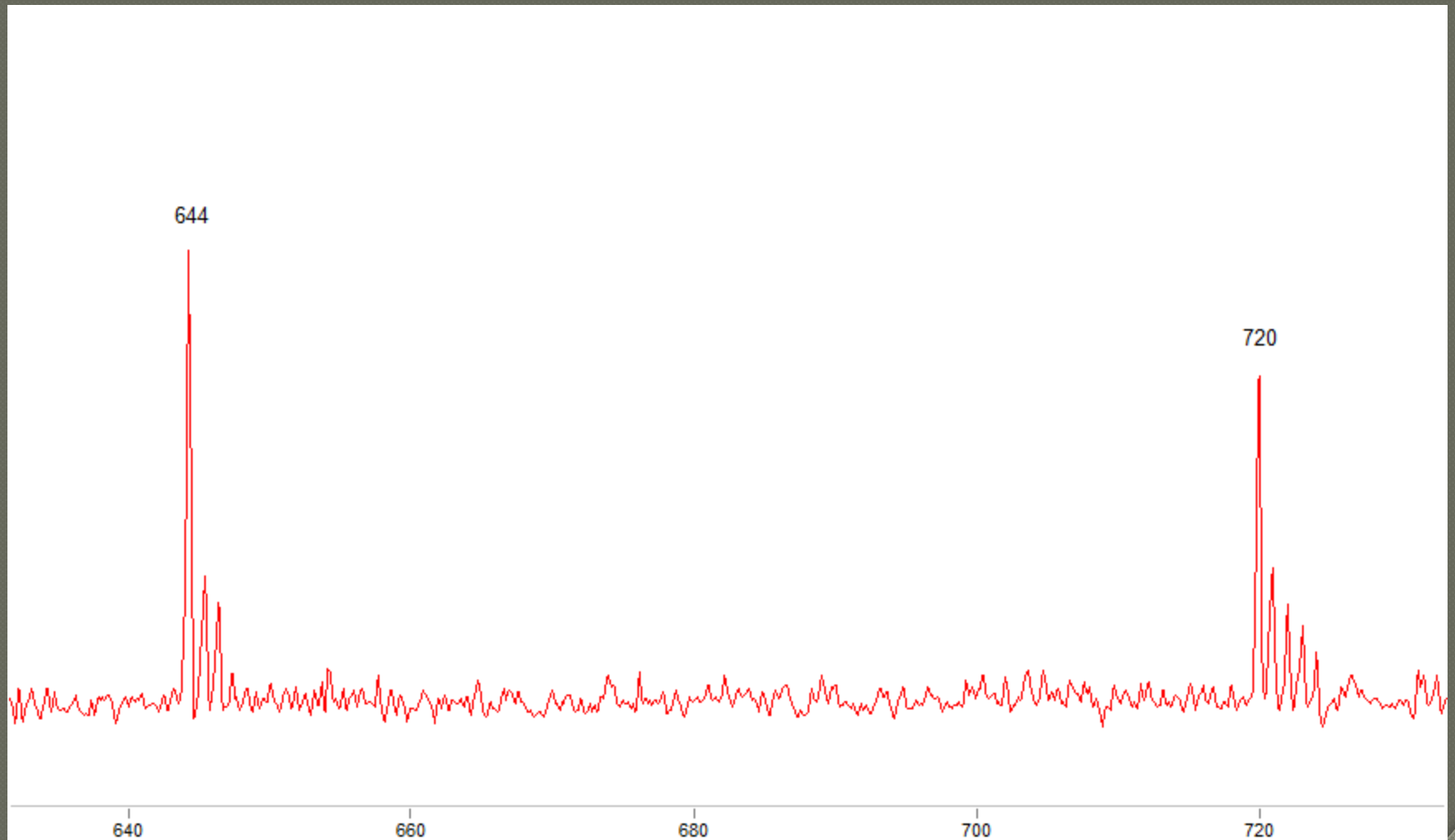
Graphite and Cyclohexane



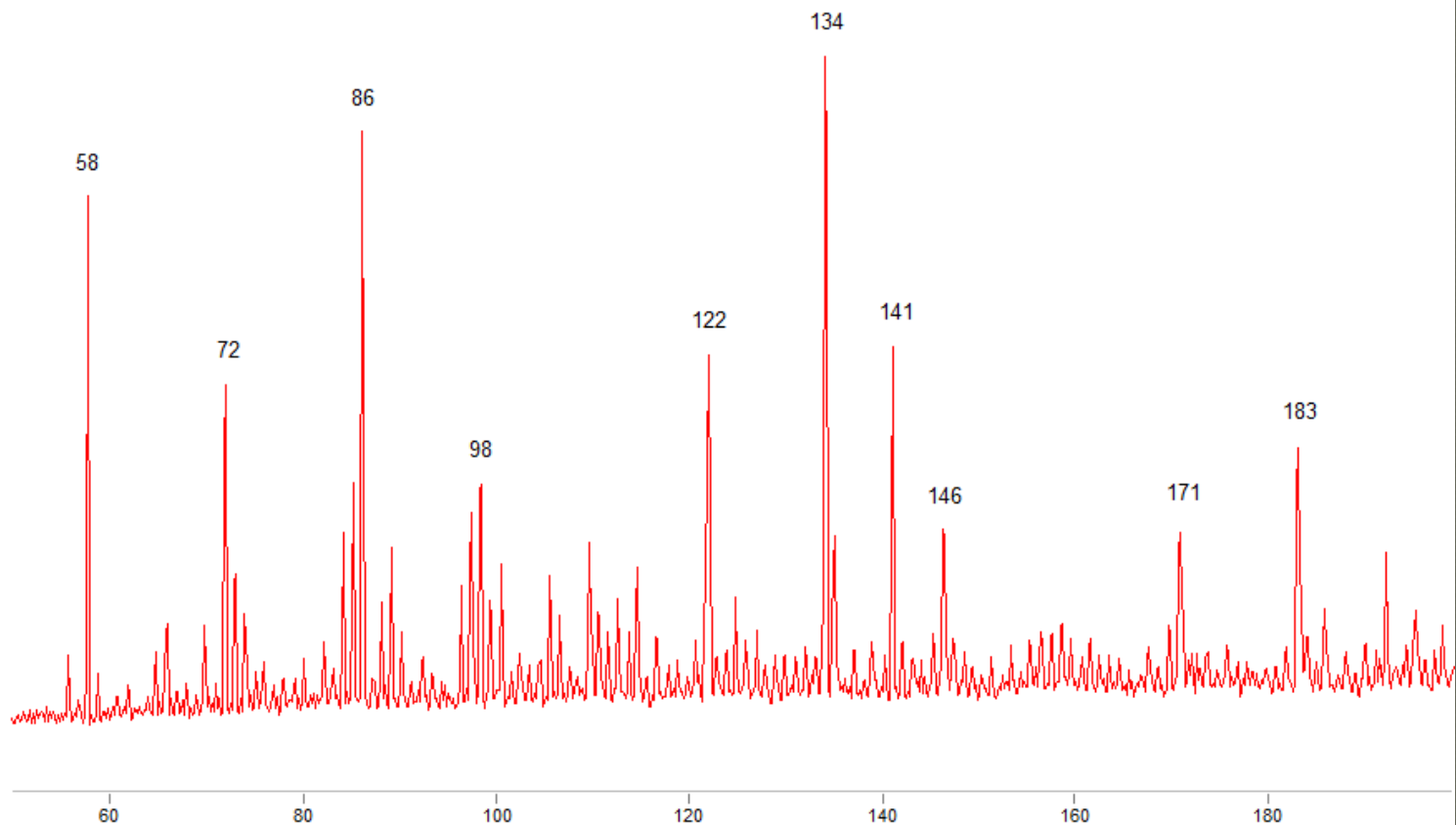
Graphite and Cyclohexane



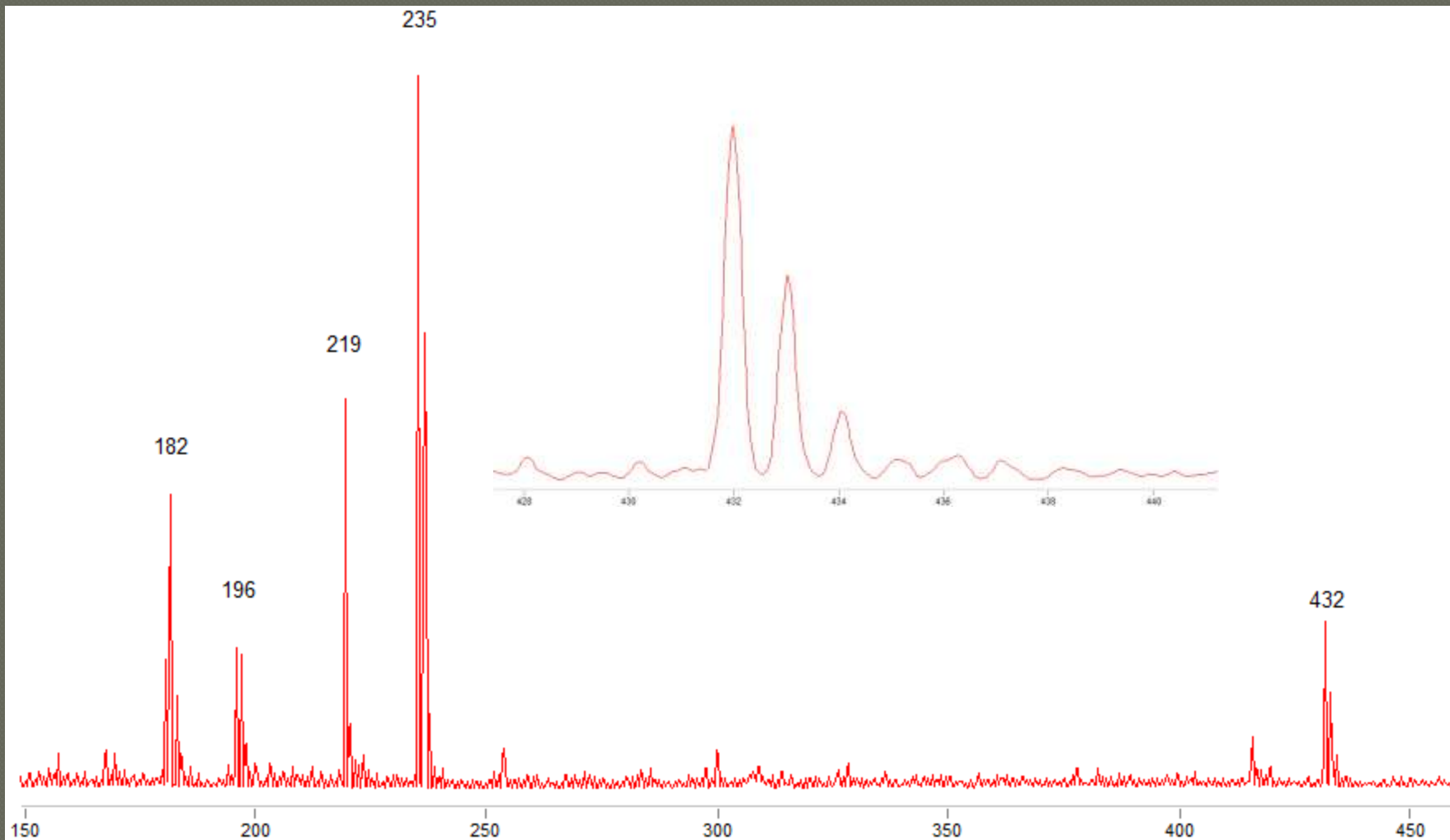
Graphite and Pentane



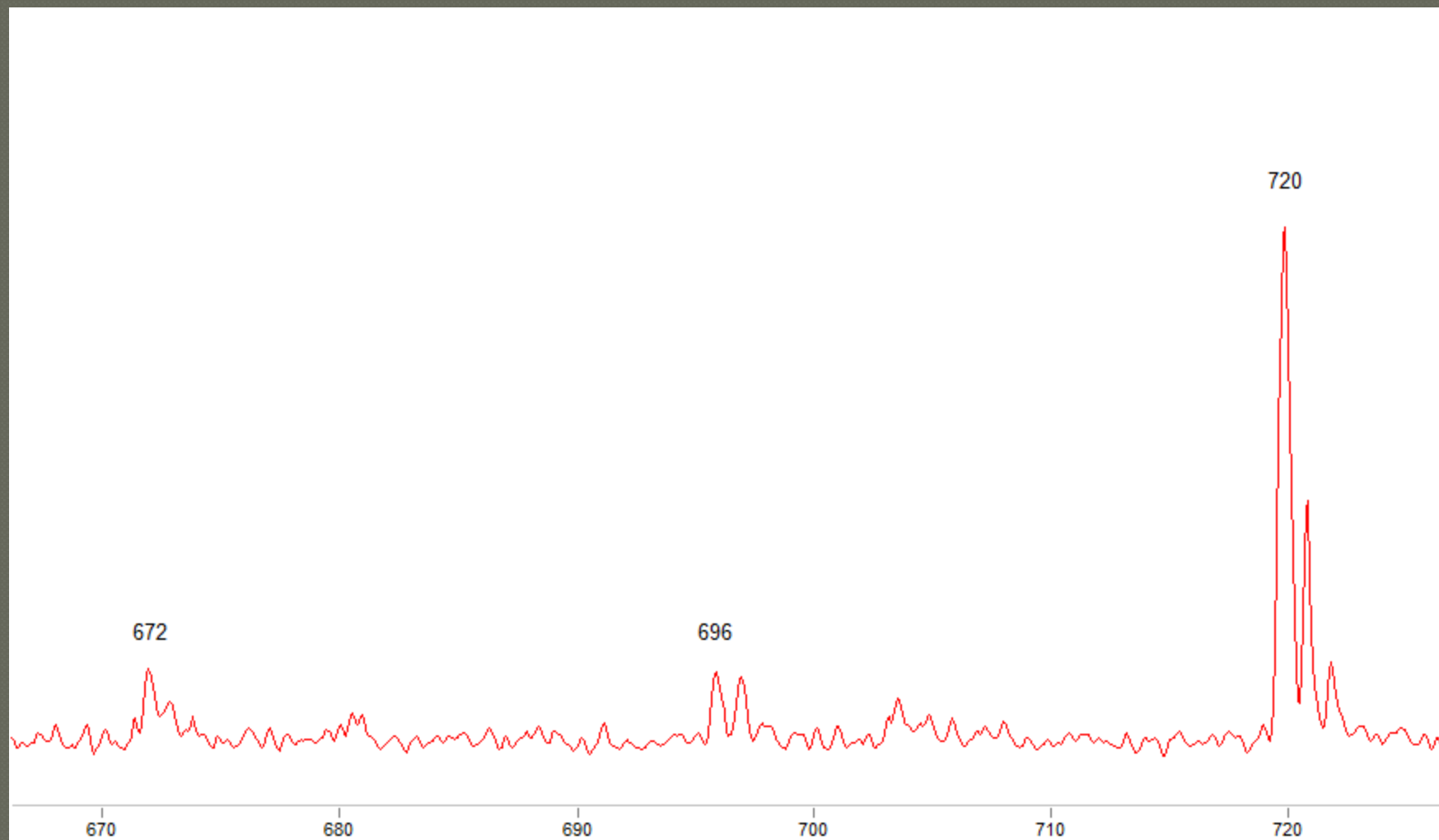
Graphite and Pentane



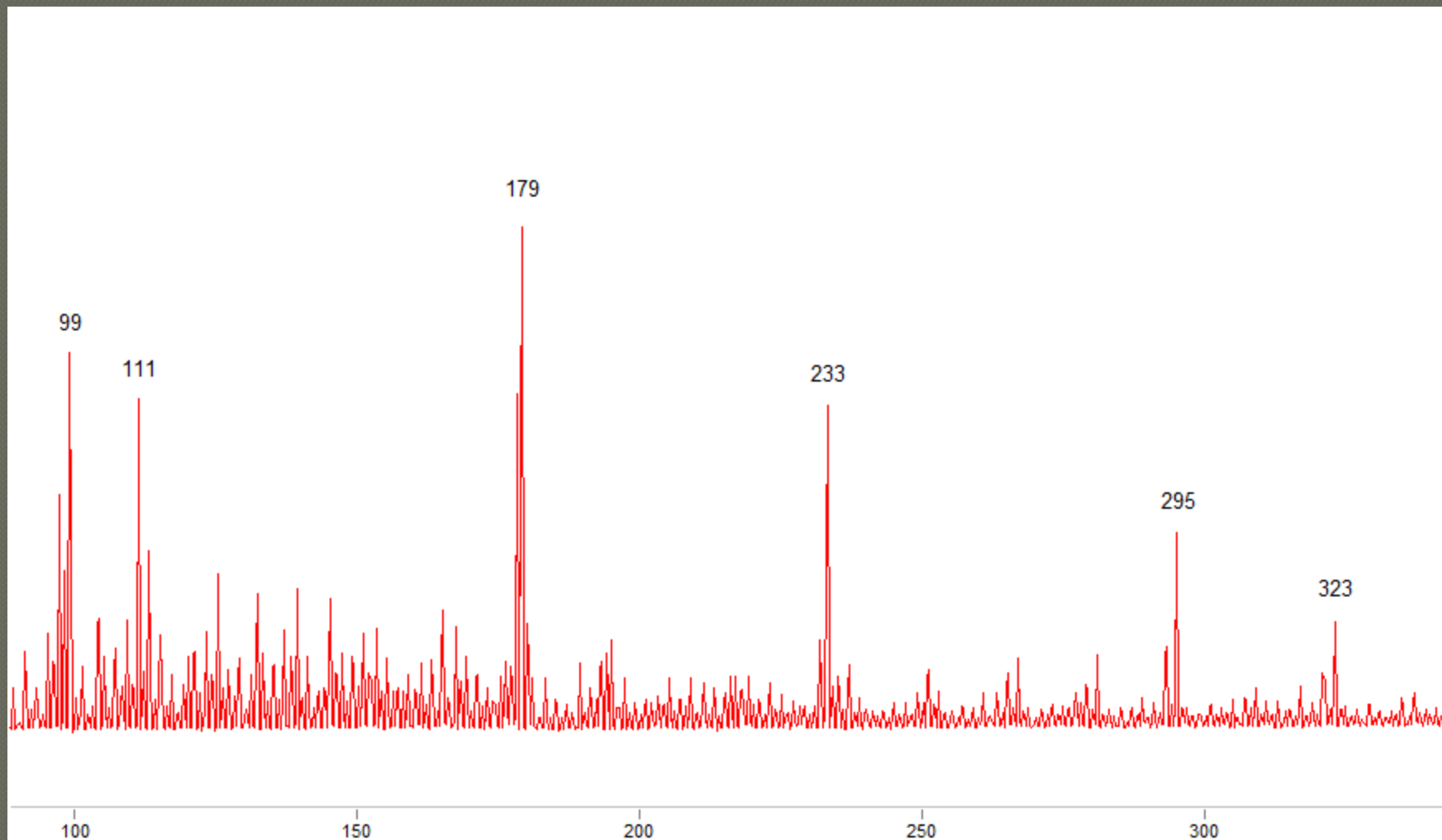
Graphite, Cyclohexane and Dihydroanthracene



Graphite, Dihydroanthracene and Toluene



Graphite, Dihydroanthracene and Toluene



Setbacks

- The original set-up
- Research
- Equipment
- Annealing
- Brittle tip



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