Laser Ablation of Solids in Liquid Environment

Summer 2010
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

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<th>ARC DISCHARGE- APPROX. 30% OF CARBON FORMS NANOTUBES.</th>
<th>CHEMICAL VAPOR DEPOSITION (CVD)- APPROX. 100% FORMS NANOTUBES.</th>
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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.
Fullerenes are cage-like structures made of carbon named after Buckminster Fuller’s geodesic domes.
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 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 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 chamber was filled with argon.
- Solution was bubbled with argon.
- Keep pressure between 300-500 torr.
- Ablate!
This is where the sample was analyzed after ablation.

Small amount of sample was put on the probe tip.
Nd: YAG laser
Mirror
Mirror
Mirror
Rotation Platform
Window
Graphite Tip
inside a beaker of a given solution.
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, 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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