

IPT project 17: Plasma

Methods and protocols

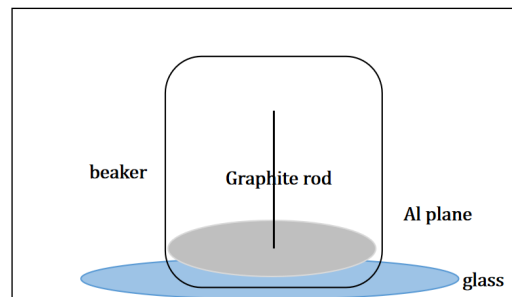
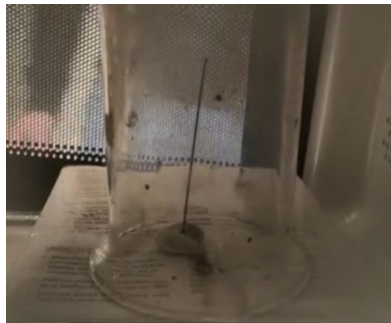
This protocol will describe in detail the instruments, methods and simulation software needed to reproduce the results of IPT project 17: Plasma.

Instrument:

Instrument	purchase link	Remark
Microwave oven	Amazon.com : microonde	Any microwave oven will do, and being able to deliver real power is a plus.
Pencil lead	Amazon.com : pencil lead	0.5mm or 0.7mm is acceptable
Clay	Amazon.com : clay	
Aluminum round bottom	Amazon.com : aluminum rod	The bottom radius is 5cm or above, and the thickness is above 3cm.
Needle	Amazon.com: 5 PCS Long Sewing Needles - 5 Size Large Eye Stitching Needles with Needle Storage Tube, 3.5inch to 6.8inch Hand Sewing Needles for Sewing Aet Crafts, Upholster	Must be conductive
Camera		Any
Spectrometer		Ocean Optics: HR4000CG-UV-NIR
Beaker	LABINVO Low Form Graduated Glass Beaker, 6pcs of Vol.500ml, 3.3 Borosilicate Glass Beaker Set, IN-BKL500: Amazon.com: Industrial & Scientific	Material should be Borosilicate

Methods for reproduction of our experiments:

1. Put a graphite rod on the reversed glass plane(it works no matter you put a aluminum plane underneath the rod or not) inside the microwave oven.We used the clay to fix it.
2. Use a beaker to cover the rod. As the figure shows below:



3. Turn on the microwave oven.
4. If it doesn't work, try to find the spot of the largest electromagnetic field and sharpen the end of the rod to make the charges more concentrated.
5. Measure the spectrum of emissions by spectrometer. We drilled a small hole in the back of the microwave so that we can observe the phenomenon with a camera and covered the indicator light inside the microwave oven with a hardboard to remove the disturbance. We put the detector on the hole and at the same time , we run the application with our computer. After getting the spectrum, we compare the pics with the database (<https://www.nist.gov/pml/atomic-spectra-database>) and find the related light emitting elements.

6. We use python to automatically control the FDTD Lumerical to simulate the distribution of the electromagnetic field. We used the Mode TE₀₁ of a rectangular source to represent the wave guide of the oven. And we used a 25×25×30cm cuboid with metal bounds to represent the oven, a combination which contains a cylinder with the length of 5.7cm and radius of 0.05cm and a cone with the length of 0.3cm and radius of 0.05cm to represent the rod.