The Fourth State of Matter

Written by Wil Menzies

Plas-ma:
a fourth state of matter distinct from solid, liquid or gas and present in stars and fusion reactors; a gas becomes a plasma when it is heated until the atoms lose all their electrons, leaving a highly electrified collection of nuclei and free electrons; "particles in space exist in the form of a plasma".

Gas filled lamps and lighting have been with us since the 1830's. In the mid-1800's the creative glass-blower Heinrich Geissler began to produce low-pressure gas tubes in a variety of sizes, shapes, and configurations. These multi-colored glowing tubes that produced plasma are attractive pieces of art and useful sources of light. The French engineer, chemist, and inventor Georges Claude was the first to apply an electrical discharge to a sealed tube of neon gas (circa 1902) to create a lamp. Georges Claude displayed the first neon lamp to the public on December 11, 1910, in Paris.

Neon lighting came very popular in advertising as the lighting was visible during the day and attracted much attention. Gas filled tubes can be used as a form of creative expression beyond the everyday "open" and "closed" signs. Of course, a couple of great examples are our featured artist, Professor Harald Eberhart and Eric Ehlenberger of New Orleans. As with much of working with glass, the equipment is very specialized and expensive. The goal of this article to explain the process of "gas filling" a tube or sculpture gas and the 3 different ways of "charging" it. It is in no way a full explanation of plasma and neon process and you should seek professional assistance before attempting a project.

First, let us understand why neon lights produce such a luminous glow. Inside the glass tube there is a gas like neon, argon or krypton at low pressure. At both ends of the tube there are metal electrodes. When you apply a high voltage to the electrodes, the neon gas ionizes, and electrons flow through the gas. These electrons excite the neon atoms and cause them to emit light that we can see. Neon emits red light when energized in this way. Other gases emit other colors. In cases such as Professor Eberhart's complex plasma sculptures or the novelty plasma balls, a single electrode or radio frequency transmitter uses DC current to exite the gas atoms.

My friend, Don Beck, happens to be the Professor of the Neon and Lampworking department at the University of Texas Arlington. I called him up and asked if he could help me by explaining the concepts of neon lighting. Never having done plasma, or RF charged gas lighting, Don was eager to experiment. I called Joe at Tecnolux to find a RF transmitter to charge a gas filled tube. Joe says "No problem, I got a couple of 'em in the back". So it began.

To start, I made a simple, clear sculpture of a flame. I left it with a blowtube attached. Don explained that the first step was to clear or purify the inside of the tubing or sculpture. In double and single electrode units, the tubing can be "bombarded". As the tube is brought toward a vacuum, an intense voltage and current is applied to the remaining air. The air heats to 550 fahrenheit and purifies the inside of the tubing. At still lower pressure levels, the electrical action 'activates' the electrodes. This process removes impurities so that pure inert gas can be introduced. On our plasma sculpture, bombardment was not an option since there was no electrode in the piece, so we brought the sculpture up to 600° F in a kiln to purify the inner tubing.

Don connected to the vacuum machine using a butt seal and brought the piece down to room temperature so the piece could accept more gas during the fill. While the piece was cooling, it was vacuumed to 10-3 torr (a torr is a unit of pressure equal to 1/760 of an atmosphere). Then a mix of neon and argon was backfilled into the sculpture. I then "tipped" the piece off of the vacuum machine. "Tipping" is a term for using the flame to separate a filled tube from the machine without losing vacuum. Again, I would like to convey that you should work with a professional for your projects. Don has 28 years in the neon game. A person should be familiar with what gases produce what colors. The colors in order of discovery were blue (Mercury), white (Co2), gold (Helium), red (Neon) then the other inert gases (Argon, Krypton, Xenon and Radon). There are also different colors from phosphor-coated tubes. Mercury is combined with the inert gas because it produces an ultraviolet light that excites the phosphor coating used on the inside of many neon tubes.

So, we purified the sculpture. Don pulled a vacuum and filled it with the gas. Now, we set in on the Glo-Tron (copyright) radio frequency transmitter, and whoa, we had a plasma sculpture. Because the plasma sculpture is electrified by a dc current, wherever you touch it, the electricity arcs to your fingers and draws the light where you are touching it. It is a very cool little "diddy" and could be useful as parts to larger installations. The Glo-Tron (copyright) is useful with small sculptures and tubing assemblies up to 4" x 4" or so. It costs around $35.00 and there are larger units available for around $75.00 that can charge larger sculptures. The small one I got came from Joe at Tecnolux. If you are truly fascinated by neon and plasma possibilities in your artwork, by all means, take a class from Harald Eberhart. There are also many resources on the web including the American Scientific Glassblowers Association (www.asgs.com), the International Neon Association and there is a list of neon schools at www.neon-shop.com.

I would like to thank Don Beck (donbeck@uta.org) at the University of Texas glassblowing Department for his hospitality. They have a full service glass facility and will soon offer a masters program as well as their ongoing BFA in glassblowing arts. Also, I would like to thank Harald Eberhart for inspiration and Joe Paciulla of Tecnolux for his support.

Web Resources:

American Scientific Glassblowers Association
www.asgs.com
Harald Eberhart
www.eberhartglass.com
International Neon Association
www.internationalneon.org
Krypton Neon - public portal for neon info.
www.neonshop.com
Museum of Neon Art
www.neonmona.org


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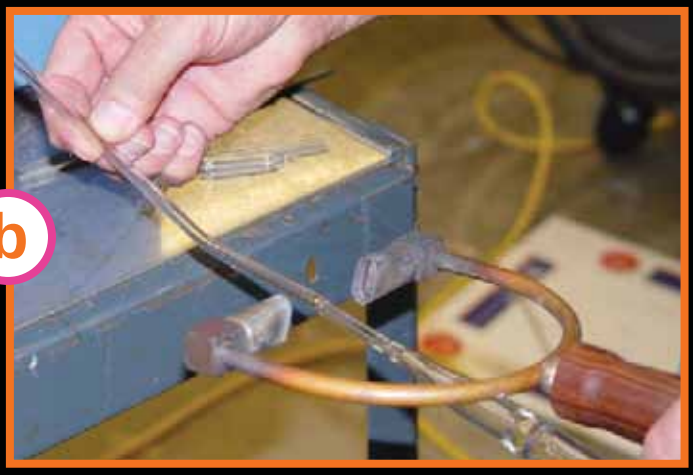
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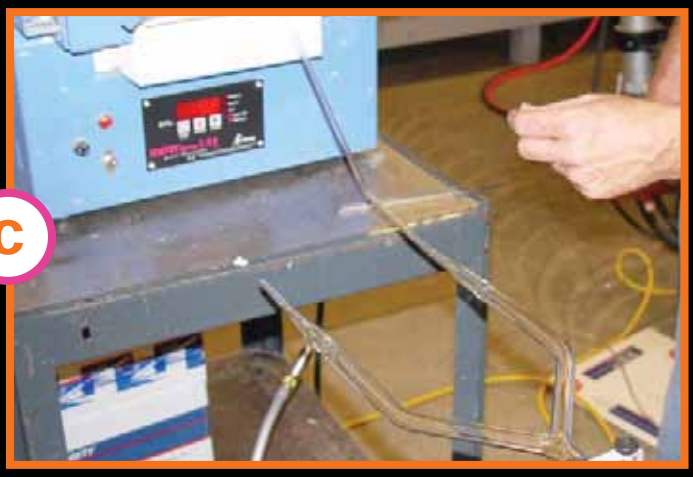
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