CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
J1619

Project Title
How Does the Spectrum of an Ionized Gas Affect the Amount of Electric Current that a Silicon Photodiode Produces?

Abstract

Objectives/Goals
The objective of my project was to determine the relationship between the spectrum of an ionized gas in an electro-luminescent tube and the amount of electric current that a silicon photodiode will produce when exposed to it's light.

Methods/Materials
I made a jig for measuring different tubes at a fixed distance in a light sealed box. All tubes were the same size and fill pressure. Using a multimeter clipped to a photodiode I could compare current readings produced by different gases. It seemed like electric current produced in a photodiode by the various gasses was not consistent with their visible brightness. I therefore tested for a relationship between this inconsistency and the ultraviolet light produced by the tubes.
With clear tubes, there was a large comparative drop in electric current from the photodiode exposed to mercury light verses mercury-phosphor light. Using a CD spectrometer and research, I found that mercury produces strong bands of light in the ultraviolet and violet range whereas silicon photodiodes are more receptive to the longer, wavelengths of light, e.g. red and infra-red.

Results
The results showed the photodiode produced the most electric current when exposed to neon light, both with and without phosphor. The photodiode made 15% less current with Ne/Hg/phosphor light than Ne/phosphor light, but pure Ne/Hg light generated 83% less current from the diode than pure Ne light. The photodiode produced 25% less current with pure Ar light than pure Ne light. Visually, Ne and Ne/Hg both give off a strong glow, red and blue respectively.

Conclusions/Discussion
For testing, I assumed silicon photodiodes read evenly across the spectrum. My hypothesis was that the brighter the visible light of a specific ionized gas exposed to a photodiode, the more electric current the photodiode would produce. The results did not support my hypothesis. By looking for the source of the discrepancies in my results, I found that photodiodes generate more current not only with more light but also with longer wavelengths of light.
Initially I was trying to find out why mercury is used in fluorescent lighting and if there is an alternative gas that can be used. As for Mercury, I learned it emits much more ultra violet light than the noble gasses. The UV is converted by phosphor into visible light. This is why mercury is used in florescent lighting.

Summary Statement
In this project, I compared the current produced by a silicon photodiode when exposed to the light of various ionized gasses in phosphor coated and clear tubes.

Help Received
Instructors at the Crucible showed me how to bend the electro-luminescent tubes and they filled them with gases. I handled no toxic materials. My Parents were present when I made my tests.