Construction of Thin Film Electroluminescent Devices

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We constructed a spinning device to which we attached a slide that was pre-coated with indium-tin-oxide. We then used this device to apply a thin film of Tris(2,2'-bipryidyl)dichloro-ruthenium(II)hexahydrate in poly(vinyl alcohol) to the slide. The ITO served as a contact on one side of the film, and we used copper wire and gallium-indium eutectic as a contact on the other side of the film. We then hooked it up to a power supply to observe electro-luminescense. The results obtained were inconclusive.

INTRODUCTION

The purpose of this experiment was to construct a spinning device that would be used to apply a thin coat of a photo-luminescent material to a slide that was pre-coated with a conductive metal. This slide would then be used to construct a circuit which would be used to observe the electro-luminescent properties of the material. Initially, we attempted to use Tris(2,2'-bipryidyl)dichloro-ruthenium(II)hexahydrate solution as a control. This solution fluoresced orange when exposed to UV light and was shown to have electro-lminescent properties[1]. We then intended to apply thin films of other metalloles exhibiting photo-luminescent properties such as hexaphenylsillole to test their electro-luminescent properties in the same manner.

EXPERIMENTAL METHOD

Synthesis of electro-luminescent material:

Reagents Used:	Source:
Poly(vinyl alcohol), 99+% hydrolized	Sigma-Aldrich
Tris(2,2'-bipryidyl)dichloro-ruthenium(II)hexahydrate	Aldrich
Ultra purified water	

TABLE I: Table of reagents we used for synthesis of Ru(bpy)

We added 300mg PVA to 10ml water, stirred continuously, and heated in microwave several times covered with parafilm for 6 sec at a time, never allowing it to boil. We then filtered the solution and added 5ml of it to a solution comprised of 53mg of Tris(2,2'-bipryidyl)dichloro-ruthenium(II)hexahydrate and 1ml water.

For an alternative solution with another metallole, we dissolved 300mg polystyrene in 10ml methylene chloride, and added 5ml of that to a solution of 40mg hexaphenylsilole and 1ml of methylene chloride.

Construction of spinning device and application of thin films to ITO slides:

We connected a 12V computer fan mounted to a piece of plywood to a 20V max power supply. We used double sided tape to mount a slide to the fan, ITO side up, and covered it with an inverted clear plastic cup with a hole in the bottom. With the slide already spinning, we dropped 10 to 15 drops directly onto the slide with a pipet through the hole in the bottom of the cup. We then let the slide spin for an additional 60 seconds before removing it and placing it either in the drying oven for an hour, or a vacuum desiccator for a week.

Assembly of electro-luminescent devices:

Reagents used:	Source
SPI Supplies Brand ITO-Coated Float Glass Unpolished Slides	Structure Probe Inc.
Gallium-indium eutectic, 99.99+%	Aldrich

TABLE II: Table of reagents we used to make device

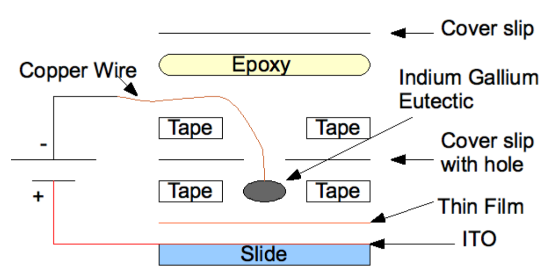

FIG. 1: Schematic diagram of light emitting device

After ensuring the thin film was dry, we assembled the device as shown in Figure 1. We punched a hole through a plastic cover slide and attached it to the surface of the thin film. We then placed a drop of the gallium-indium eutectic into the hole in the cover slide. A copper wire was then placed so that it made contact with the eutectic, and extended past one edge of the assembly. 5 minute epoxy was then applied directly to the top of that, and a cover slide was placed on top to seal everything in place.

Once the epoxy was dry, the positive lead of the power supply was connected to a corner of the ITO slide that had been cleaned off so that it made direct contact with the ITO slide (cathode). The negative lead was connected to the copper wire (anode). We then turned the power supply on starting at $4V$ and working our way up to $12V$.

RESULTS

No luminescence was observed, save for an instance where some light was observed but we postulate it was the plastic cover slides and tape residue melting or burning. At one point we thought we may have seen some glowing that looked like more than sparks, but this was most likely due to the plastic cover slides and tape residue either melting or burning as there was charring observed under normal light after the experiment was concluded.

DISCUSSION

We experimented with various methods to try to find a successful method to get the thin film to emit visible luminescence. These included increasing the concentration of Tris(2,2'-bipryidyl)dichlororuthenium(II)hexahydrate in PVA, increasing the viscosity of the solution by increasing the amount of PVA in H_2O, and using polystyrene with methylene chloride instead of the PVA and H_2O. Furthermore, we tried covering the slide completely with solution before spinning, but the results showed the formation of radial lines in the film. We made some films with one layer, and others with several layers added in succession to make the thin film thicker. Additionally, we tried adding the solution by dropping it onto the film at different heights.

The best results were obtained by dropping 10 to 15 drops on the already spinning slide with the drop transferring directly from the tip of the pipet to the slide without dropping any distance. $12V$ worked best on the fan, spinning the slide at $4826rpm$. In construction of the circuit, we followed the instructions outlined in [1] as closely as possible, though they were not entirely clear and they did not provide a very clear diagram of how the device was set up.

[1] Sevian, in *Journal of Chemical Education* (University of Massachusetts - Bostonm MA, 2004).