Teacher's Preparatory Guide

Building a Rainbow – Extension Activity

The CHALLENGE

This here is my personal secret, so unfortunately your own creativity will be required to do it (perhaps some bonus points are due here…) BUT, HERE ARE SOME HINTS…

You have now practiced building thin films which give rise to different colors due to the thin film effect. Remember that the material is the same, but because the film is thinner than the light's wavelength, the color is mostly a result of the nanoscale thickness of the film.

The challenge here is that previously the area was ALWAYS THE SAME, so the current is always the same. This means we can always use the SAME RESISTOR ALL THE TIME, how convenient…

If we want to build a rainbow over the surface, we need to expose more and more area, meaning more and more current, meaning a different resistance each time, what a pain!

Here's a trick: Use two ITO pieces, one piece is big, the piece we care about is much smaller and masked so that the TOTAL AREA, although it is changing, it changes so little each time you want to change a color on the small piece, it makes really no difference overall, so again we use the same resistor. We'll need a deeper container, perhaps that other beaker you never used will be handy…

One problem, all the data you collected was based on one area, the area you masked. That's okay, you want your other ITO surface to be Cu_2O coated anyway, so first find the condition that gets you similar results timewise, or even collect new data. (Remember, you will need less resistance for the larger area, try the calculation again).

Also, how will you controllably insert the working (smaller) ITO electrode in the solution? One choice is to always remove it, rinse off the old mask in methanol, and remask it with a slightly bigger window. Can you think of a more elegant method? Perhaps stack a bunch of pennies and remove them one at a time? What about those camera tripods? They say duct tape works wonders in all walks of life. Perhaps an empty paper towel roll duct-taped to a tripod..., whatever.

Conclusion:

Write a paragraph to describe the results of the experiment and your reflections on your experiences during this lab.

Developed by Dan Allred
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[The hope here is that students should start becoming aware that elements and compounds are insufficient in explaining the phenomena in the world, and that nanoscale effects are observed when materials that are very small are made. Thus, size is also important, and the observation that by merely changing the size of something, and nothing else, can profoundly influence our impression of what we observe the object to be. There can be so many numerous ways this is expressed that no answer should be construed as wrong, and credit should be awarded to any honest attempt to write anything that appears as if students are very confused by the simplicity of the procedure and the dramatic variations in results, especially if they compare with other groups. No one will get the same results with such crude equipment.]

Summary Questions:

Provide some summary questions to aid students' reflections here – for example:

1. Where *does* color come from, the material or the light?
2. When does size matter?
3. What kinds of materials could stop the *thin film* effect?

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