Investigating the Impacts of Dye Color on Energy Production of Luminescent Solar Concentrators

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Luminescent solar concentrators (LSC) utilize fluorescent dyes in a transparent material to absorb diffuse radiation in the ultraviolet region and re-emit it as visible light. The emitted light can then be guided to photovoltaic cells along the edges of the material by internal reflectance. LSC are attractive for their ability to produce electricity in low light conditions. However, LSC remain in the research and development phase with most research focusing on optimizing the material. This experiment focuses on how different colored fluorescent dyes in a polymethyl methacrylate sheet impact energy production of photovoltaic cells under different lighting. To test this, commercially produced fluorescent polymethyl methacrylate of 5 different colors as well as a non-fluorescent clear piece (the control) were cut into 55 mm squares to which photovoltaic cells were affixed to the edges. The voltage each LSC produced was measured under both an ultraviolet lamp and white halogen lamp. Under the ultraviolet lamp the orange LSC produced on average the most voltage (1.57 V) with the blue a close second producing 1.55 V. The clear LSC on average generated the least voltage (0.45 V). The LSC all performed similarly under the white halogen light, all producing between 1.7 and 2 volts. This shows that under an ultraviolet lamp fluorescent dye impacts LSC voltage due to UV lights conversion into visible light via the Stokes shift process of fluorescence, but has little impact when UV light is not present based on the similar physical properties of the material.

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