



Photo-luminescent Targets in Space

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OVERVIEW

Photo-luminescent (“glow in the dark”) products have seen a dramatic increase in performance in the last 15 years with the use of a strontium aluminate formulation. Because of this, ISS uses photo-luminescent markers for interior emergency egress guidance. The marker is COTS material composed of strontium aluminate doped with europium, imbedded in PVC and achieves a light emission performance rated at 600/90 (600 mcd at 10 minutes and 90 mcd at 1 hour, 2 mcd is minimum required for human visibility). The ICA goal is to determine this material’s effectiveness for use externally on ISS and/or on visiting vehicles, when packaged in Lexan for UV protection. A thermal test was conducted by EC to characterize the luminance emission profile of the material at extreme cold and hot temperatures, such as experienced on ISS.

INNOVATION

Photo-luminescent (“Glow in the dark”) markings can provide visible guidance in the dark for EVA, robotics or vehicle detection. Since most orbiting vehicles are exposed to a 90 minute cycle of sunlight, markers can be regularly charged during daylight. This is a minimal cost, passive technique to provide visibility with an unlimited charging cycle. The goal is to provide assistance for operations in the dark for both humans and machines.

INFUSION SPACE / EARTH

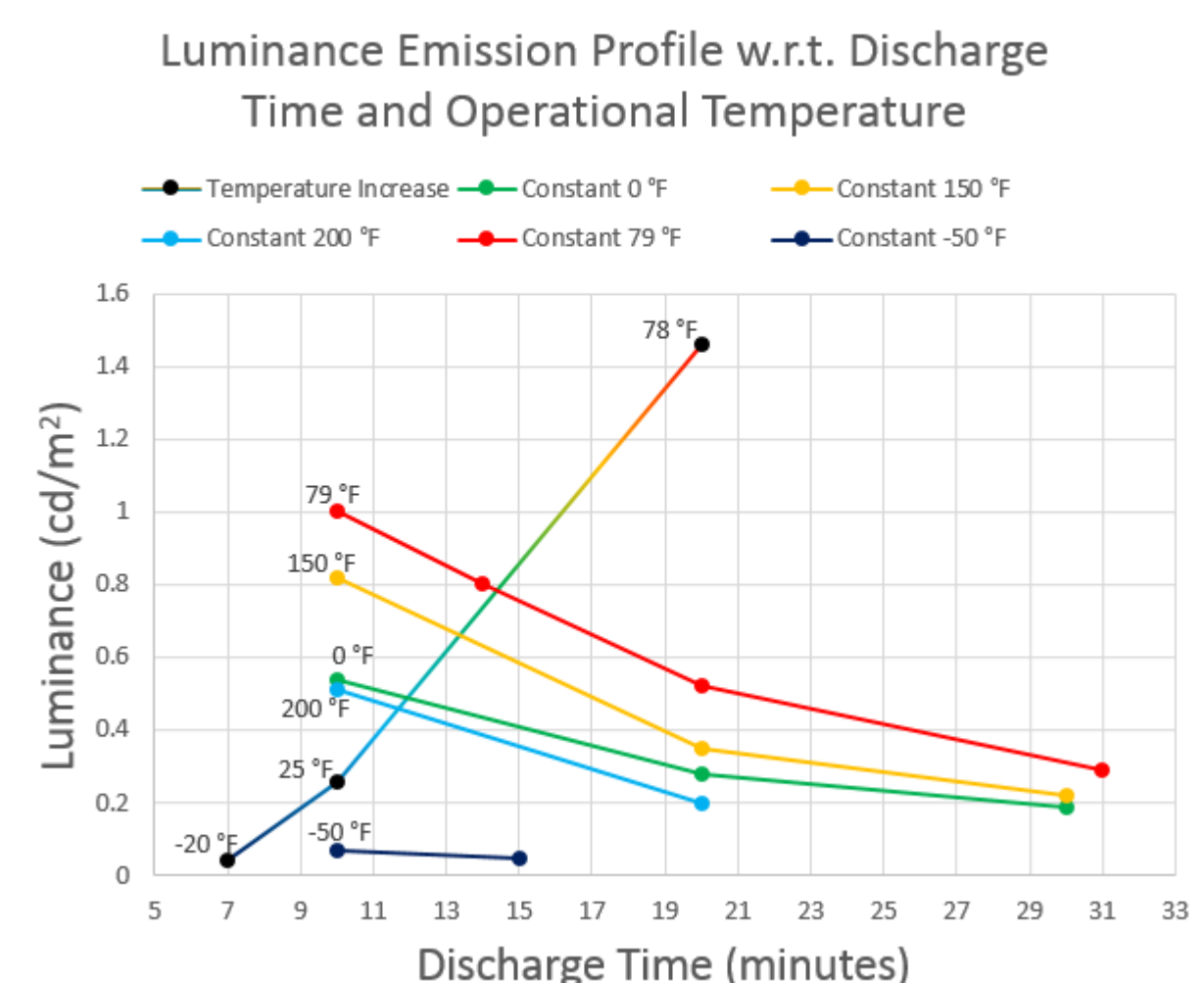
The last time “glow in the dark” technology (radio-luminescence) was used for human interfacing (external hand rails) was during Apollo missions. Since that time, “glow in the dark” technology using photoluminescence has significantly improved (10x in brightness and duration) for consideration as external space hardware.

FUTURE WORK

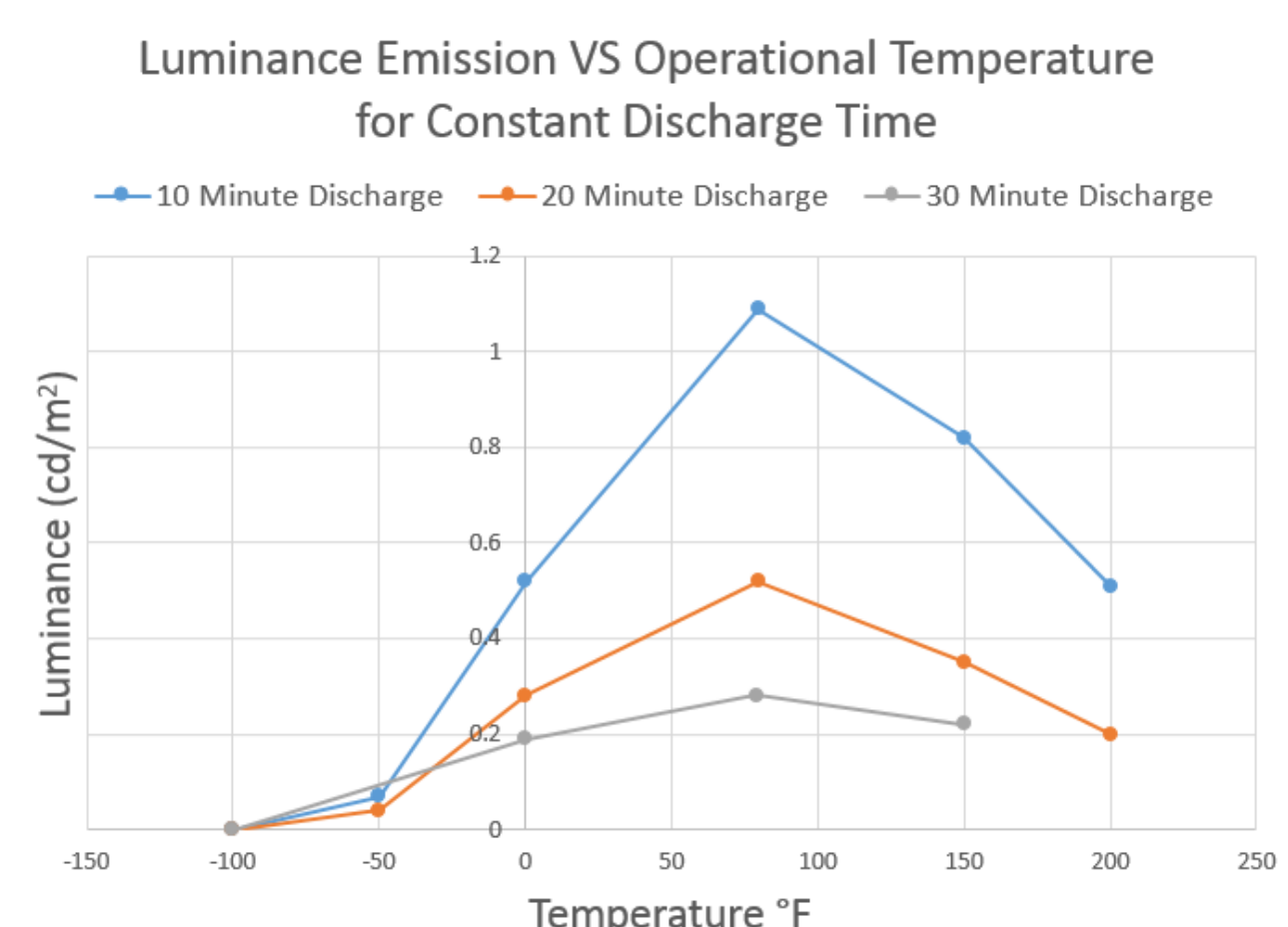
The packaging of the photo-luminescent material can be modified to test other UV and temperature protective materials. Also, other photo-luminescent materials may be found that do not experience operational degradation at extreme temperatures.

OUTCOME

The experimental data from the thermal test is summarized in the plot below. Lines of constant color represent luminance emission time profiles for constant operational temperatures achieved by the thermal chamber. Note that luminance exponentially decays with increasing discharge time for a constant temperature.



We discovered the charging and emission capabilities of the material are significantly reduced at low temperature. For example, at -100°F the material’s luminance was too low to measure through the chamber porthole. At peculiar effect was noticed that when fully charged (using 33K lux light source) at 100°F is rapidly cooled to -50 °F and increased to 78°F, its emission output changed accordingly, suspending emission at cold temperatures. It was also determined that the material’s emission degrades somewhat at higher temperature, but remains visible to the human eye at 200°F. Luminance visibility (>2mcd) for human eye was in the range of -50 °F to 200°F. However, visibility for cameras is less promising.



ACKNOWLEDGEMENTS

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