Experimental Studies of Cathodoluminescence in Type I Chondrule Analogs. John M. DeHart and Gary E. Lofgren. Mail Code SN2, Johnson Space Center, Houston, TX 77058.

Introduction: Type I chondrules have distinct cathodoluminescence (CL) properties that are probably related to their unique chemistry and formational history (1, 2). The Fe-poor olivines and pyroxenes found in these chondrules most often emit red CL, although occasional grains that emit blue CL have also been noted (2, 3). These grains are embedded in refractory mesostases that emit yellow CL in chondrules found in meteorites of the lowest petrologic type (Semarkona and Bishunpur, types 3.0), but emit blue CL in meteorites of higher type. This difference in the CL properties of type I chondrule mesostases is believed to be due to physical changes in either composition or structure caused by the effects of low level thermal metamorphism, and has tentatively been used to discriminate between the petrologic types 3.0 and 3.1 (4). Before this property can be reliably used as an indicator of thermal metamorphism, the phosphor responsible for the yellow CL emission must be identified and the mechanism for this change in CL properties understood. Toward this end, we are conducting a search of previous dynamic crystallization experiments (5, 6) for type I analogs and plan additional experiments using compositions similar to type I chondrule compositions.

Observations: One dynamic crystallization experiment was identified as a good analog of type I chondrules in both the phases present and their CL properties. This experiment contained Fe-poor olivines (Fo_{99}) in a mesostasis composed of a Ca-Al rich phase similar in composition to mesostases in type I chondrules, but had small pockets of SiO_2 rich glass distributed throughout it. CL studies of this experiment showed the olivines emitted red light and the SiO_2 rich glass emitted blue light. The Ca-Al rich phase initially emitted a bright yellow light that changed under the beam first to a dull yellow-brown color and then to a dull red color over a period of approximately 30 minutes. Reexamination of this experimental charge at a later date showed that the CL emission from the Ca-Al rich phase was still dull red.

Interpretations: Red luminescence from the olivines in this experiment is consistent with the CL properties previously observed from olivines with this composition (1, 3). The small pockets of SiO_2 rich glass that emits blue light has also been previously observed in chondrules (7). The phosphor that emits yellow light in the Ca-Al rich mesostases of the experiment must have been unstable with respect to some condition of the CL analysis. The most likely cause is the heating samples undergo during electron bombardment. The instability of the Ca-Al rich mesostasis phase which initially emitted yellow CL suggests a second mechanism that may explain how the change in Type I chondrule mesostases can occur. The change from yellow to blue CL most likely does not represent a change in the wavelength of emission from a single phosphor. Instead this change could be caused by the degradation of an initially brighter yellow phosphor so that phases which emit blue CL (such as the areas of SiO_2 rich glasses in the experiments, and probably feldspar in Type I chondrule mesostases) will dominate the overall emission from the mesostases. Since the sources of CL in chondrule mesostases are micron to submicron in size, what is observed is a change in color of the whole area from yellow to blue. Yellow emission is intense enough to mask blue emission in the first case and blue emission bright enough to mask red emission in the second case. Although no conversion of CL color has been observed to take place in type I chondrule mesostases during conventional CL studies, this could be due to a slightly higher transition temperature because of a different composition of the phosphor, or possibly different heat capacities of the experimental and natural mesostases.

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Conclusions: These data provide additional evidence that yellow luminescing phases in Ca-Al rich glasses undergo alteration when exposed to modest increases in temperatures. Although there are some significant differences between the natural and experimental mesostases in this study, there is enough similarity in their respective CL properties to warrant further investigation.

References. (1) DeHart, J.M., Lofgren, G.E. and D.W.G. Sears, LPSC XX, pp. 228-229. (2) Jones, R.H. and Scott, E.R.D. (1989) Proc. XIX LPSC, pp. 523-536. (3) Steele, I.M. (1986) GCA, **50**, pp. 1379-1395. (4) DeHart, J.M. (1989) Doctoral Dissertation, University of Arkansas. (5) Lofgren and Russell (1986) GCA, **50**, pp. 715-726 (6) Lofgren (1989) GCA **53**, pp. 561-570 (7) Brigham, C.A. et al (1987) GCA, **50**, pp. 1655-1666.