

Thermoluminescence of primitive ordinary chondrites, Semarkona and Bishunpur. K. Ninagawa,¹ I. Yamamoto,² M. Kohata,² T. Wada,³ Y. Yamashita,³ J. Lu,⁴ D. W. G. Sears,⁴ S. Matsunami⁵ and H. Nishimura.⁵ ¹Dept. Applied Phys., Okayama Univ. of Sci., Ridai-cho 1-1, Okayama 700, Japan. ²Dept. Electronic Engin., Okayama Univ. of Sci., Ridai-cho 1-1, Okayama 700, Japan. ³Dept. Phys., Okayama Univ., Tsushima-cho 3-1-1, Okayama 700, Japan. ⁴Cosmochemistry Group, Dept. Chem. and Biochem., Univ. of Arkansas, Fayetteville, Arkansas 72701, USA. ⁵Dept. Geosci., Naruto Univ. of Education, Takashima, Naruto 772, Japan.

A thermoluminescence (TL) spatial distribution readout system attached to a microscope has been developed (Ninagawa *et al.*, 1990). This system becomes, moreover, a time-resolving spectroscopy system, substituting a spectroscope for the microscope (Ninagawa *et al.*, 1986). The induced TL sensitivity of ordinary chondrites increases by a factor

of 10^5 with metamorphism and the primitive ordinary chondrites such as Semarkona (LL3.0) and Bishunpur (LL3.1) have the lowest TL sensitivities (Sears, 1988). However, we investigated induced TL images and glow curves of them by the TL spatial distribution readout system over a wide range of wavelengths with a Corning 4-96 filter.

A chondrule with anorthite-normative mesostasis in Semarkona, which is a porphyritic olivine chondrule [Fo_{99.5-99.7}] of type IA according to Scott and Taylor (1983), shows especially high induced TL intensity with a 300 °C glow peak and a zonal structure. We measured high TL intensity although it would have the lowest TL sensitivity. The TL spectra from Semarkona were also measured by the time-resolving spectroscopy system. While the TL spectra of equilibrated ordinary chondrites are known to have a 450 nm peak in a low-temperature region and a 400 nm peak in a high-temperature region, they have a peak at ~570 nm and agree with those of some plagioclase feldspars in which Mn²⁺ ions act as luminescence centers (Huntley *et al.*, 1988). The Corning 4-69 and 7-59 filter assemblies used in most TL measuring systems limit the detection wavelength from 320 nm to 480 nm while the 4-96 filter transmits 570 nm emission. The "low TL sensitivity" of the primitive ordinary chondrites is in part due to limiting the detection wavelengths to ultraviolet-blue region. The cathodoluminescence of this chondrule was also measured. This chondrule shows the yellow cathodoluminescence in anorthite-normative mesostasis and the zonal structure, and it is classified to group A1 of Sears *et al.* (1992). The yellow cathodoluminescence is consistent with the ~570 nm TL emission.

A barred olivine chondrule in Bishunpur also shows an unusual glow curve with a ~110 °C peak and a peak above 440 °C, different from the above glow curve. The TL spectra from Bishunpur have the same ~570 nm peaks. This barred olivine chondrule shows also the yellow cathodoluminescence in anorthite-normative mesostasis and it is classified to group A1. On the other hand, a porphyritic olivine chondrule of type II in Bishunpur shows an usual glow curve with a ~170 °C peak and blue cathodoluminescence in albite-normative mesostasis, and it is classified to group A5.

The results are that 1) some chondrules in Semarkona and Bishunpur show high TL intensities although such primitive ordinary chondrites would have low TL sensitivity, 2) these high TL intensities are due to ~570 nm emission, which is consistent with the yellow cathodoluminescence in anorthite-normative mesostases, beside the usual blue TL emissions from albite-normative mesostasis, 3) they show a variety of