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Themoluminescence and compositional zoning in the mesostasis of a Semarkona Group A1 chondrule and new insights into the chondrule-forming process. S. Matsunami,[1] K. Ninagawa,[2] I. Yamamoto,[3] M. Kohata,[3] T. Wada,[4] Y. Yamashita,[4] J. Lu,[5] D. W. G. Sears[5] and H. Nishimura.[1] [1]Naruto Univ. of Education, Naruto 772, Japan. [2]Dept. Applied Phys., Okayama Univ. of Sci., Ridai-cho 1-1, Okayama 700, Japan. [3] Dept. Electronic Engin., Okayama Univ. of Sci., Ridai-cho 1-1, Okayama 700, Japan. [4]Dept. Phys., Okayama Univ., Tsushimanaka 3-1-1, Okayama 700, Japan. [5] Cosmochemistry Group, Dept. Chem. and Biochem., Univ. of Arkansas, Fayetteville, Arkansas 72701, USA.

A large group A1 (Sears *et al.,* 1992) porphyritic olivine chondrule in the Semarkona (LL3.0) chondrite with induced thermoluminescence (TL) and compositional zoning in its mesostasis has been discovered. The presence of both Ca-rich, Fe-poor olivine (CaO 0.36–0.40 wt%, $Fa_{0.3-0.5}$) and highly anorthite-normative mesostasis (~52.5 wt%) is consistent with observations on type-IA chondrules in Semarkona (Jones and Scott, 1989). A TL spatial distribution readout system (Ninagawa *et al.,* 1990) has revealed that the induced TL increases monotonously by a factor of ~6 from center to rim, while SiO_2, Na_2O and MnO increase by factors of ~1.1, ~3.6, and ~6, respectively. The mesostasis also shows a concentric zoning of yellow cathodoluminescence (CL). The spectrum of the induced TL and the Mn-TL correlation suggest that Mn-activated plagioclase is an important constituent of the refractory mesostases in group A1 chondrules.

The zoning may reflect fractional crystallization, Soret diffusion, transport of volatiles into the chondrule by aqueous alteration, a zoned precursor, reduction of precursor dust aggregate or recondensation of volatiles lost during chondrule formation. The first four possibilities seem unlikely explanations for the zoning of the mesostasis. The formational process of the zoning is suggested as follows: (1) During the temperature rise of chondrule-forming event, a precursor dust aggregate composed of FeO-bearing olivine, Ca-rich plagioclase and Ca-rich pyroxene was reduced through the interaction with a reducing nebular gas. The reduction process caused increase of silica content at the marginal part. (2) During melting of the precursor, Na and Mn evaporated from the chondrule melt. (3) During the cooling, forsterite phenocrysts crystallized in the melt. The residual liquid became rich in anorthite component. (4) Subsequently Na and Mn recondensed onto the surface and diffused into the interior, forming the zoning of Na and Mn. (5) Mn-bearing anorthite then crystallized in the mesostasis. The Mn-zoning caused the difference of Mn-contents in anorthite crystallized in the mesostasis, finally leading to the formation of TL and CL zoning.

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