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Laboratory Experiment on the MGAL2O4 Spinel Formation

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Spinel is one of the major oxides found in meteorites or chondrites, such as CM2 meteorite Murray or CI chondrite Orgueil (Huss et al.1994; Zinner et al.2005). It condenses at 1513K from a cooling gas of cosmic composition at thermodynamic equilibrium and disappears at 1362K due to the formation of anorthite (CaAl2Si2O8) (Grossman 1972). However, it was expected that spinel did not appear in a theory of the nonequilibrium process. The spinel formation on solid-solid reaction was proposed (Yamamoto & Hasegawa 1977). One of the present authors demonstrated the formation of spinel by MgO solid- Al2O3 solid reaction. On the other hand, the 12-13 um emission feature was found in the spectra of oxygen-rich AGB stars by ISO spectra observation. The origin of this feature was identified as gamma-alumina particle (Onaka et al.1989) or spinel (Posch et al.1999; Fabian et al. 2001). In this paper, the direct production method of spinel phase dusts has been presented. The flash evaporation method was used in the mixture gas of Ar (45 Torr) and O2 (5 Torr). Various mixture powder of Mg and Al was flashed onto Ta boat heated above 2100K. The oxidation of Mg and Al vapor took place in the smoke. Two atom mixture particles were produced accompanying to morphological change based on the spinel structure. By decreasing Mg contents, the shape of particle changed to the cubic, octahedron, ellipse and spherical particles. The characteristic spectra among these produced particles have been indicated. The difference of absorption positions of new 14 and 18 um features was discussed on the shape effect of spinel phase.