Laboratory production of crystalline and amorphous forsterite grains

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The observation of crystalline silicates by the Infrared Space Observatory changed our view of silicates. Recently we produced crystalline forsterite grains by the coalescence and growth between Mg and SiO smokes [1] and MgO and SiO_2 smokes [2]. The exothermic energy of the oxidation of Mg can drive the formation of the forsterite grains. When the amount of SiO vapor is higher, amorphous Mg-bearing silicate grains were predominately produced. In the present study, the flash evaporation method has been examined on the formation of forsterite. A mixture powder of Mg and SiO with the atomic ratio of 1:1, 1:2, 1:4 or 1:8 was dropped onto the heated Ta boat at 2300-2400 K in an Ar gas (80 Torr) or a mixture gas of Ar (70 Torr) and O_2 (10 Torr). The produced grains were observed transmission electron microscopy. Spherical forsterite grains with the size of less than 100 nm can be produced preferentially at the atomic ratio of 1:2. Amorphous Mg-bearing spherical silicate was preferentially produced at 1:4 and 1:8. MgO and SiO grains were predominately produced at 1:1 and 1:8, respectively. Typical collected particles have been indicated in the fig. 1. The result in the mixture gas was similar trend. The defect such as dislocation hardly existed in the grains. The IR spectra on these particles may be used as the stress free spectra.

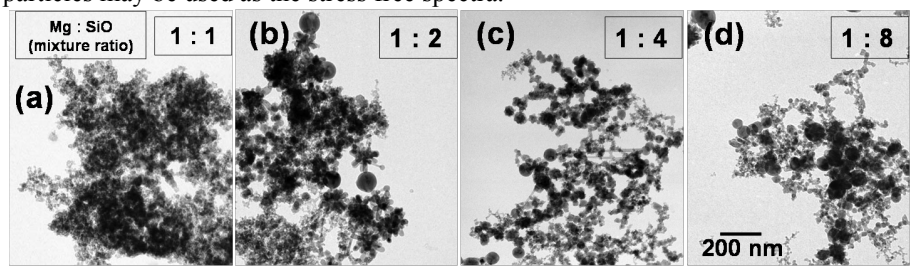

Figure 1. Produced smoke particles produced using the flash evaporation method. The top ratio indicates the mixture ratio of powder.

References

[1] C. Kaito et al., *Meteor. Planet. Sci*., **38**, 49 (2003).
[2] K. kamitsuji et al., *Astron. Astrophys.* **429**, 205 (2005).