Low Temperature Crystallization
of Thin Amorphous Silicate Layer on the Crystalline Fe Dust

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To explain how cometary silicates crystallize yet still pressure volatile interstellar ices in their parent comets, we experimentally demonstrated the possibility of chemical-reaction-driven crystallization [1], which is called nonthermal crystallization [2] by using laboratory-synthesized amorphous Mg-bearing silicate grains [3]. Successive the previous low-temperature crystallization of amorphous dust, iron grains covered with a SiO layer was used as the model sample. Figure 1 shows the enlargement image of Fe grains heated at 100ºC for 44 hours. Most grown form of the iron particles was rhombic dodecahedron covered with twelve (110) planes [4]. These particles can be seen as the different shapes along the zone axis. The (110) lattice image of iron particle region is clearly seen. The parallel fringes seen on the SiO_2 film region shows the parallel growth of α-SiO_2 (202) and (101) planes, i.e., $(110)_{Fe}$ // $(101)_{SiO2}$. This suggests that SiO layer altered to the crystalline SiO_2 layer by the heating at 100ºC in air by the oxidation of Si crystallites on the surface of iron crystalline grain. Thermal energy diffusion difference between amorphous and crystal introduced the crystallization from the crystal dust surface.

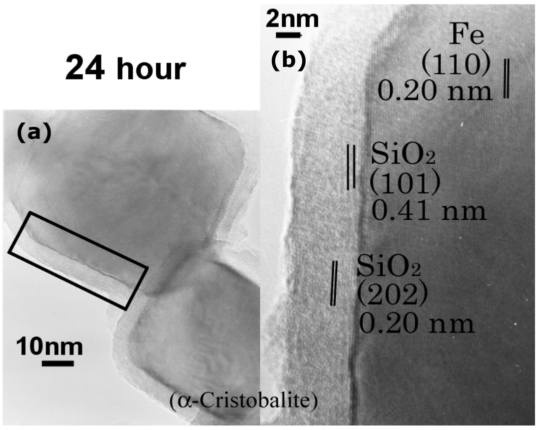

Figure 1. After heated at 100ºC 24 hours, HRTEM image shows that (202) and (101) lattice images of crystal appeared parallel to the (110) surface of Fe.

References

[1] C. Kaito et al., *ApJ* **666,** 657 (2007).
[2] T. Yamamoto and T. Chigai, *Highlights Astron.* **13,** 522 (2005).
[3] K. Kamitsuji et al., *Astron. Astrophys.* **429,** 205 (2005).
[4] C. Kaito and K. Fujita, *Sci. Form.* **2,** 37 (1986).