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Comet-like particle growth in Al-SiO

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When a metal was evaporated in an inert gas atmosphere, a vapor of the metal cooled and formed nanoparticles by collision with the inert gas molecules. The nanoparticles grow by coalescence growth and rise on a convection flow of the gas like a smoke. The nanoparticle production method is called a gas evaporation method.

SiO consists of Si and SiO_2. Metal nanoparticles covered with an amorphous SiO layer can be produced by evaporating a mixture powder of the SiO and a metal. However, comet-like particles were grown in the rising smoke using a few kinds of metals[1)]. In the case of Cr-SiO particle produced by the gas evaporation method, Si was dissolved in a Cr drop at a high temperature region in a smoke. The Si dissolved in the Cr drop was crystallized by supersaturation on cooling process. The Si crystal grew like a tail and the Cr drop became $CrSi_2$ crystal like a core of come-like particle. The comet-like particle grew around the eutectic point between Si and $CrSi_2$. Thus, the comet-like particle grew like a VLS mechanism.

Since Al has a eutectic point with Si, the comet-like particle growth was expected using a mixture powder of Al and SiO. Production of the comet-like particles was tried by the gas evaporation method.

Comet like-particles were produced by evaporation of Al and SiO mixture powder in Ar gas $1.0*10^4$ Pa. The particles were observed by TEM, and analyzed by EDS. It was found that a core part of the comet-like particle consisted of Al or Al and Si, a tail part consisted of Al and O by EDS analysis. ED patterns of the particles indicated that structure of the core part was Si and Al crystals, and the tail part was Al_2O_3 single crystal. Composition of Al and Si in the core part depended on the ratio of Al and Si in the mixture powder. The tail part structure was always Al_2O_3 in every composition. The comet-like particles were grown like a VLS mechanism with SiO2 reduction and Al oxidation.

1) C. Kaito et.al, J. Crystal Growth **200** (1999) 271.

Keywords: Nanoparticle, Whisker, Al, Si, Al_2O_3, TEM