JASMAC Conference of the Japan Society of Microgravity Appllication

OR2-6

# 過冷却液滴からの準安定γアルミナ相の形成とラマン分光による結晶相評価

# Formation of Metastable γ-Alumina Phase from Supercooled Droplets and Crystal Phase Evaluation by Raman Spectroscopy

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## 1. Introduction

Metastable γ-$Al_2O_3$ is widely used as a catalyst support[1)], because of its attractive intrinsic acid-base characteristics, mechanical properties and adjustable surface physicochemical properties. Understanding its formation mechanism under non-equilibrium conditions is therefore of significant interest from both scientific and practical aspects. Our previous research using an aerodynamic levitator revealed the possibility that metastable γ-$Al_2O_3$ can nucleate under deeply under cooled $Al_2O_3$ liquid followed by the growth of stable α-$Al_2O_3$ phase. However, preferential formation conditions of the metastable γ-$Al_2O_3$ remain unclear, since the obtained sample was a mixture of stable and metastable $Al_2O_3$. In this study, we have attempted to apply micro-Raman spectroscopy to evaluate the formation of the metastable γ-$Al_2O_3$ phase.

## 2. Experiment

A spherical α-$Al_2O_3$ sample (diameter: 2 mm) was levitated in an Ar gas flow using the aerodynamic levitator and then melted by $CO_2$ laser irradiation. The temperature of the samples was measured with a two-color radiation thermometer, which was calibrated based on Wien's law using the liquidus temperature. The solidification process was observed in real time, and the resulting crystal structures were analyzed using Raman spectroscopy.

## 3. Results and discussion

Figure 1 shows the results of Raman spectroscopy performed on the solidified $Al_2O_3$ samples. The red spectrum corresponds to the surface of a sample with a supercooling of 108 K, while the black spectrum represents the surface of a sample with a supercooling of 83 K. In both cases, distinct peaks were observed at 381, 578, 648, and 750 $cm^{-1}$, which are characteristic of α-$Al_2O_3$[2)], indicating successful crystallization. Notably,

a peak around 410 $cm^{-1}$ was also detected, which is not typically attributed to $\alpha$-$Al_2O_3$. These observations suggest that the different in the degree of undercooling affect the stable and metastable $Al_2O_3$ formation.

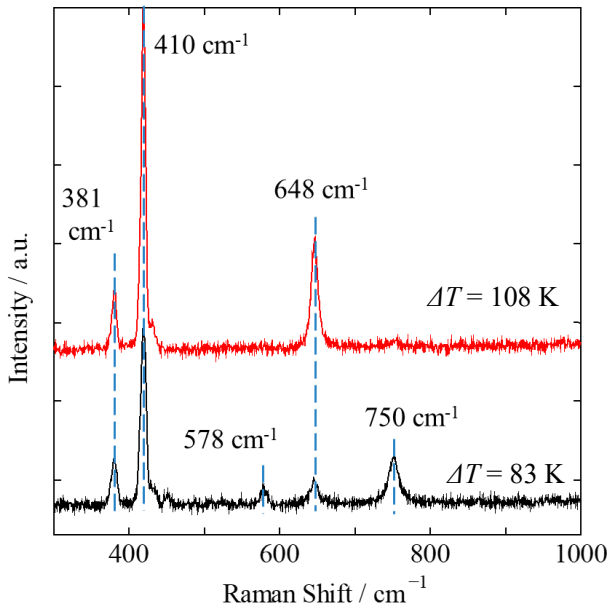


**Figure 1**. Raman spectrum of the solidified $Al_2O_3$ sample.

## References

1) S. Tabesh, et al, *Journal of Alloys and Compounds*, **730**(2018) 441. https://doi.org/10.1016/j.jallcom.2017.09.246
2) H. Kimachi, et al., *Journal of the Society of Materials Science*, **58**(2009) 603. https://doi.org/10.2472/jsms.58.603