

## Deposition of $\text{Cs}_2\text{Mo}_2\text{O}_7$ on Au, Pt and SUS304 in Argon

\*Thi-Mai-Dung Do<sup>1</sup>, Supamard Sujatanond<sup>2</sup> and Toru Ogawa<sup>1</sup>

<sup>1</sup>Nagaoka University of Technology, <sup>2</sup>Thammasat University.

### Abstract

Deposition by heating  $\text{Cs}_2\text{Mo}_2\text{O}_7$  on Au, Pt and SUS304 in flowing argon was studied. The deposits on each type of substrates were analyzed by micro-Raman, XRD, EPMA in order to understand the behavior of  $\text{Cs}_2\text{Mo}_2\text{O}_7$ .  $\text{Cs}_2\text{Mo}_2\text{O}_7$  reacted with components in SUS304 to form various species depending on the temperature.

**Keywords:**  $\text{Cs}_2\text{MoO}_4$ ,  $\text{Cs}_2\text{Mo}_2\text{O}_7$ ,  $\text{Cs}_2\text{CrO}_4$ , SUS304, deposition.

### 1. Introduction

In severe accident of Light Water Reactor, one of the predominant forms of released cesium is considered  $\text{Cs}_2\text{MoO}_4$ . In some conditions, such as in steam,  $\text{Cs}_2\text{MoO}_4$  can change to  $\text{Cs}_2\text{Mo}_2\text{O}_7$  [1]. The vaporization and deposition behaviors of  $\text{Cs}_2\text{Mo}_2\text{O}_7$  in various atmospheres and substrates are not yet clear. In order to understand the behavior of cesium polymolybdates, the deposits of  $\text{Cs}_2\text{Mo}_2\text{O}_7$  on pure Au, Pt and SUS304 in argon were studied. The Au and Pt substrates were used to confirm the vapor species in the absence of the reactions with the substrate.

### 2. Experimental Procedure

$\text{Cs}_2\text{Mo}_2\text{O}_7$  was prepared as follows. Stoichiometric mixture of  $\text{Cs}_2\text{CO}_3$  (extra pure 99.9 %) and  $\text{MoO}_3$  (99.9%) powders were heated at 873 K for 1 hour and then held at 673 K for 6 hours in air. The product was identified as  $\text{Cs}_2\text{Mo}_2\text{O}_7$  by micro-Raman spectroscopy.

$\text{Cs}_2\text{Mo}_2\text{O}_7$  powder was placed in a platinum boat and heated in a horizontal alumina tube in a silicon furnace. Inner surface of the alumina tube was covered by Pt thin foil with 0.1 ~ 0.2  $\mu\text{m}$  thickness in order to prevent the reaction between  $\text{Cs}_2\text{Mo}_2\text{O}_7$  and  $\text{Al}_2\text{O}_3$ . The heating condition was 1573 K for 1 hour in flowing argon. Either Au (99.95%) or Pt (99.99%) (10 x 10 x 0.1 mm each) or SUS304 pieces (20 x 10 x 1 mm) were placed at the different positions ranging from 50 to 250 mm downstream from the platinum boat. Outlet gas was trapped with water. The temperatures of Pt and SUS304 pieces ranged from 500 K to 1573 K, and those of Au from 500 K to 1200 K. After the heating, the deposits on Au, Pt and SUS304 pieces were examined with the X-ray diffraction, the electron probe microanalyzer (EPMA) and the micro-Raman spectroscopy.

### 2. Results

The deposits on Au or Pt were  $\text{Cs}_2\text{Mo}_2\text{O}_7$  at high temperatures, and slightly hydrolyzed  $\text{Cs}_2\text{Mo}_2\text{O}_7$  at lower temperatures.

On SUS304, character of the deposits varied with the substrate position. At temperature higher than 1530 K, the deposits on the surface were Mo and  $\text{MoO}_2$ . At 1500 K, the deposits were Mo,  $\text{MoO}_2$ ,  $\text{Cs}_2\text{Mo}_2\text{O}_7$  and  $\text{Cs}_2\text{MoO}_4$ . Raman peaks ascribable to  $\text{Cs}_2\text{CrO}_4$  were observed also (Fig. 1). In EPMA mapping, Cs, Cr and O stayed together in some areas. At 1230 K, the deposit was  $\text{Cs}_2\text{MoO}_4$  and  $\text{MoO}_2$ .

### 3. Summary

The deposition by heating  $\text{Cs}_2\text{Mo}_2\text{O}_7$  on Au or Pt in flowing argon were confirmed as  $\text{Cs}_2\text{Mo}_2\text{O}_7$ , this suggests that  $\text{Cs}_2\text{Mo}_2\text{O}_7$  vaporizes as dimolybdate molecule rather than as  $\text{Cs}_2\text{MoO}_4$  (g) +  $\text{MoO}_3$  (g).

The deposits on SUS304 varied with temperature due to reactions between  $\text{Cs}_2\text{Mo}_2\text{O}_7$  with the components in SUS304.

### References

[1] S. Sujatanond and T. Ogawa, Vaporization and behavior of Cesium molybdate and Cesium Polymolybdates, AESJ, Spring, 2014.

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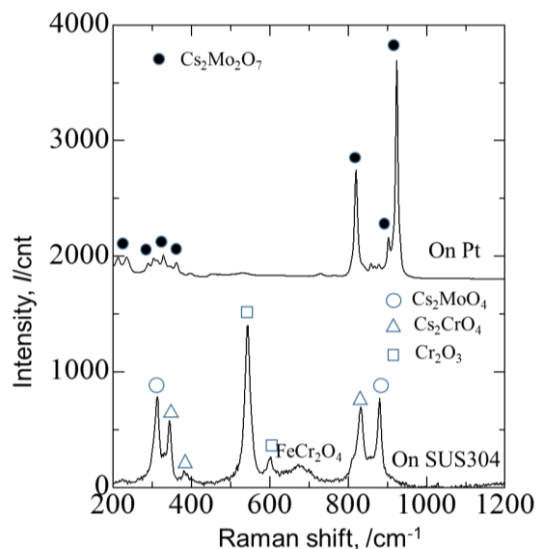


Fig. 1 Deposits on Pt was  $\text{Cs}_2\text{Mo}_2\text{O}_7$  and on SUS304 was  $\text{Cs}_2\text{MoO}_4$  and  $\text{Cs}_2\text{CrO}_4$ ; T= 1500 K