The reaction between cesium hydroxide and stainless steel oxidation products in a steam environment at 573K-773K

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This study investigates the reactions between cesium hydroxide (CsOH) and stainless steel oxidation products, magnetite (Fe_3O_4) and chromia (Cr_2O_3) in argon and argon-steam environments at 573K-773K.

Keywords: Cesium hydroxide, Metal oxides, Hygroscopicity, High temperature steam

1. Introduction

The interaction between CsOH and structural materials may change the form of Cs and attenuate or delay the transport. Recent studies have shown that CsOH can react with stainless steel to form ferrites below 600℃.[1] Reaction between CsOH and Fe_3O_4 as well as Cr_2O_3, as the most possible metal oxides of stainless steel in reactor environments, has been conducted in Ar gas and Ar-steam stream under 573-773K.

2. Experimental method

$CsOH{\cdot}H_2O$ powder (Combi-Blocks, 95%) and Fe_3O_4 powder or Cr_2O_3 powder was mixed in mortar and then formed into cylindrical pellets. The molar ratio was set as Cs:Fe = 1:1 or Cs:Cr = 1:1. Then the pellets were heated in the tube furnace in Ar or Ar-steam stream under 573K-773K for 1h. Then samples were crushed and grinded into fine powder. Scanning electron microscope (SEM) JSM-IT200 (JEOL) has been used for observation, elemental analysis and phase identification. Sample preparation was carried out in a glove box due to hygroscopicity of samples. The weight changes of the samples before and after the experiment have been recorded.

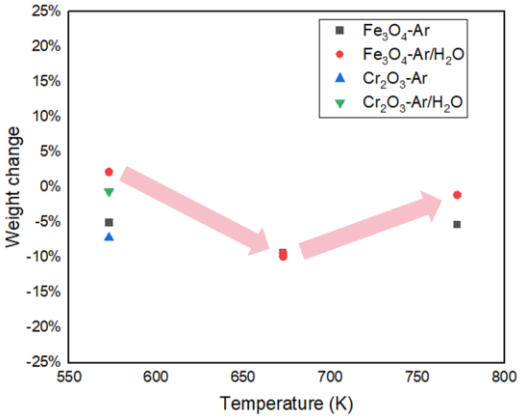

Figure 1 Weight change in different conditions

3. Results

XRD patterns for mixed $CsOH{\cdot}H_2O$-Fe_3O_4 samples after experiment are shown in Figure 1. Due to the strong hygroscopicity, XRD patterns for mixed $CsOH{\cdot}H_2O$-Cr_2O_3 samples could not be obtained. The changes in appearance and weight are shown in Figure 2. Results showed that the reactions between CsOH and Fe_3O_4 produced identical phases ($CsFeO_2$) and less hygroscopicity compared to CsOH regardless of temperature and atmosphere. The highest reaction rate was around 673K. In contrast, reactions between CsOH and Cr_2O_3 resulted in similar appearances across different conditions and still exhibited high hygroscopicity.

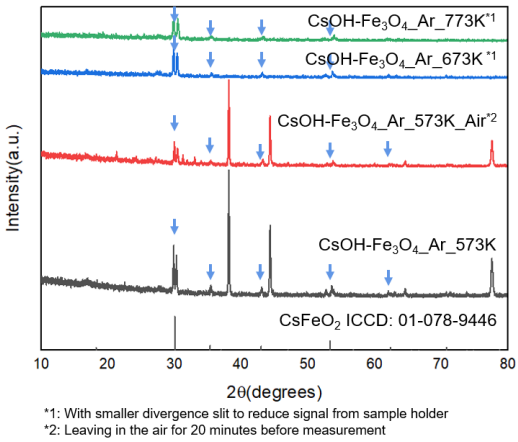

Figure 2 XRD patterns for mixed $CsOH{\cdot}H_2O$-Fe_3O_4 samples after experiment

References

[1] Jumpei Imoto et al., AESJ Annual Meeting 2E17.