

# Analysis of Thermal and Magnetic Properties by adding Ta to Co-based and Fe-based Amorphous Alloys

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## 1. Introduction

Since the discovery of metallic glasses by Duwez et al. [1] in 1960, the metallic glasses have become new materials. Co-based and Fe-based alloys have a good possibility in various applications, for instance power devices, sensors, motors, transformers, and energy converting supplies [2,3]. Also, Fe-Co alloys system have been researched that the alloys have a good glass-forming ability (GFA). Furthermore, adding Ta to alloys is important to enhance GFA and thermal stability by increasing negative bonding between elements. Also, adding Ta improves the soft magnetic properties [4].

We studied on magnetic and thermal properties of  $(\text{Co}_{1-x}\text{Fe}_x)_{72}\text{B}_{19.2}\text{Si}_{4.8}\text{Ta}_4$  ( $0 \leq x \leq 1$ ) alloys which are Co-based or Fe-based amorphous ribbons. In previous studies, we examined the thermal and magnetic properties by making a small quantity of Cr and Ta addition to Co-Fe alloys [5].

## 2. Experiment

$(\text{Co}_{1-x}\text{Fe}_x)_{72}\text{B}_{19.2}\text{Si}_{4.8}\text{Ta}_4$  ( $0 \leq x \leq 1$ ) alloys were made by vacuum arc melting furnace under argon atmosphere and re-melted four times for homogeneity of alloys. Then, the result of arc melting, i.e. ingot re-melted and rapidly cooled by melt spinning machine in 39.27m/s. As a result, those alloys are transformed into 2mm ribbons. After processing of ribbons, we identified ribbons' magnetic and thermal property by various measuring equipment. The structure of amorphous is confirmed by X-ray diffraction (XRD). Magnetic properties are established by vibrating sample magnetometer (VSM) and thermal properties, such as the crystallization temperature ( $T_x$ ), the glass transition temperature ( $T_g$ ), and the supercooled liquid region ( $\Delta T_x = T_x - T_g$ ) are measured by using differential scanning calorimeter (DSC).

## 3. Result and discussion

In this examination, we conducted more study on Co-Fe-B-Si-Ta system than earlier research in order to study deep into the thermal and the magnetic properties for Co-Fe based amorphous alloys.  $(\text{Co}_{1-x}\text{Fe}_x)_{72}\text{B}_{19.2}\text{Si}_{4.8}\text{Ta}_4$  ( $0 \leq x \leq 1$ ) amorphous ribbons showed good soft magnetic properties. That amorphous ribbons had high saturation magnetization and had no crystal anisotropy. So those ribbons are suitable for amorphous applications which require good soft magnetic properties.

## 4. References

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