

**New Functional Co-base Alloys  
– Phase Stability and Its Industrial Applications –**

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**【Outline of survey】**

Co-base alloys have been widely used as corrosion / erosion resistant, high-temperature magnetic and biomedical materials. However, the phase diagrams which are the basic information necessary for the development of advanced Co-base alloys have not been studied as extensively as in other alloy systems. Therefore, the purpose of the proposed study is to examine the phase equilibria of Co-base alloys experimentally as well as by thermodynamic analysis with the aim of constructing a thermodynamic database for the Co-base alloy system. Based on phase diagram research, the following studies will be conducted to develop new functional Co-base alloys.

- (1) Co-base superalloys: Our group recently found a new  $\gamma'$  phase  $\text{Co}_3(\text{Al}, \text{W})$  with  $\text{L1}_2$  structure which exhibits inverse temperature dependence of flow stress as well as the  $\gamma'$  phase,  $\text{Ni}_3\text{Al}$  in the Ni-base superalloys. Therefore, the present study will be focused on the microstructural evolution, mechanical properties and other high temperature characteristics to develop a new type of Co-base superalloys.
- (2) Magnetic recording media: Co-Cr-base sputtered films have been used for high-density magnetic recording media. Co-Cr-base film is made up of Co-rich ferromagnetic hcp nanosized grains surrounded by a Co-poor paramagnetic hcp phase, which is attributed to magnetically induced phase separation. Since a similar phase separation appears in the Co-Mo and Co-W-base alloys, the microstructure, magnetic properties and optimum sputtering conditions will be studied.
- (3) Medical device: Based on preliminary investigation of the formation of the second phase in the Co matrix and removal of the phase in the surface by a chemical or physical method, Co-base porous metals will be prepared to develop a new type of drug eluting vascular stent.

**【Expected results】**

The construction of a thermodynamic database for the Co-base alloy system can be expected to be a powerful tool for utilization not only in the development of commercial Co-base alloys but also for the development of advanced materials. Furthermore, the research on

- (i) Co-base superalloys (ii) magnetic recording media and (iii) drug eluting stent will be conducted utilizing a new process developed by the present group. In particular, it is expected that the development of Co-base superalloys will result in the reduction of  $\text{CO}_2$ .

**【References by the principal investigator】**

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- H. Chinen, J. Sato, T. Omori, K. Oikawa, I. Ohnuma, R. Kainuma and K. Ishida, "New ternary compound  $\text{Co}_3(\text{Ge}, \text{W})$  with  $\text{L1}_2$  structure", *Scripta Materialia* 56 (2006), 141-143.
- T. Omori, Y. Sutou, K. Oikawa, R. Kainuma and K. Ishida, "Shape memory and magnetic properties of Co-Al ferromagnetic shape memory alloys", *Materials Science and Engineering A*, 438-440 (2006), 1045-1049.

**【Term of project】** FY2007–2011

**【Budget allocation】** 27,400,000 yen

(2007 direct cost)

**【Homepage address】**

<http://www.material.tohoku.ac.jp/jp/labs/metal03.html>