Phase diagram of the Gd-Ti binary system

INTRODUCTION

The design and processing of metallic alloys requires a detailed knowledge of their thermodynamic properties. Differential thermal analysis provides this information and, with the help of complementary techniques, allows the determination of accurate phase diagrams. In the example reported here, the binary Gd-Ti phase diagram has been studied as a subsystem of the intermetallic compound Co-Gd-Ti. This compound is of great interest for its magnetic properties.

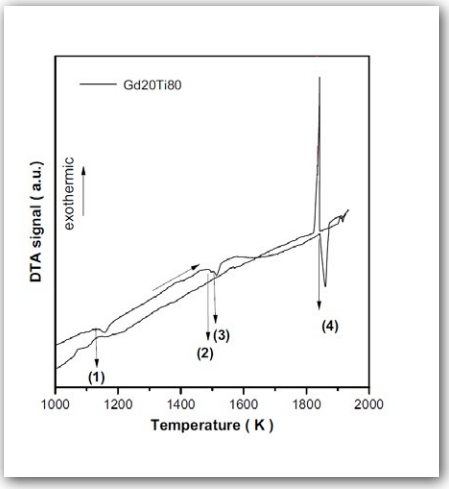

Figure 1 – DTA thermogram of Gd20Ti80. The endotherms observed during heating are indicated by numbers on the graph.

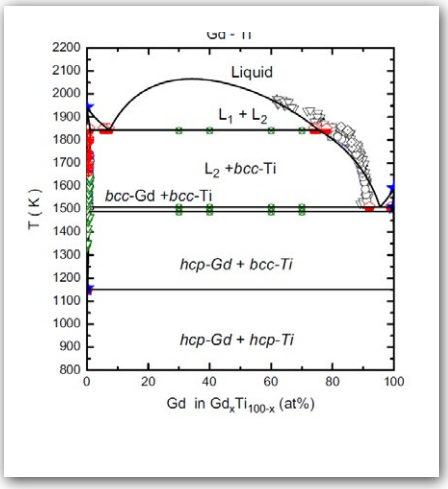

Figure 2 – phase diagram of the Gd-Ti system as obtained by DTA (green crossed circles) and other techniques like XRD, SEM. The lines are calculated using the CALPHAD method.

EXPERIMENT

- Instrument : THEMYS DTA
- Sample: Gd20TI80
- Atmosphere: helium flow
- Crucible : zirconia
- Temperature : Heating and cooling from room temperature to 1950K at 10K/min

Reference : N. Mattern et al, Experimental and thermodynamic assessment of the Gd–Ti system, Calphad, Volume 42, 2013, Pages 19-26.

RESULTS AND CONCLUSION

The DTA scan observed in figure 1 showed four significant endothermic peaks. Thanks to extra analytical techniques like XRD, each could be associated to a specific phase transition:

(1) Eutectoid bcc-Ti(Gd) <-> hcp-Gd(Ti) + hcp-Ti(Gd) at 1140 K
(2) Eutectoid bcc-Gd(Ti) <-> hcp-Gd(Ti) + bcc-Ti(Gd) at 1488 K
(3) Eutectic L <-> bcc-Gd(Ti) + bcc-Ti(Gd) at 1508 K
(4) Monotectic L1 <-> L2 + bcc-Ti(Gd) at 1841 K

Several GdxTi100-x samples could be tested the same way, and the experimental data were used to plot the Gd-Ti binary phase diagram as showed on Figure 2.

INSTRUMENT

THEMYS STA

ACCURATE AND SENSITIVE ULTRA-HIGH TEMPERATURE
heat flow measurement with Tri- Couple DTA technology

ULTRA-HIGH TEMPERATURE CAPABILITY
to 2400°C with a single furnace.

MODULAR ADAPTIONS ALLOWING
TGA only, DTA only, TG-DTA, and TMA up to 2400°C, DSC only and TG-DSC up to 1600°C all in one instrument

EXTERNAL COUPLING CAPABILITY
designed for evolved gas analyzers (FTIR, MS, GCMS, MSFTIR, or FTIR-GCMS)