Data Article

Dataset on the microstructure Ni\(_{50}\)Mn\(_{38}\)Sb\(_{9}\)Si\(_{3}\) alloy and compositions of Ni\(_{50}\)Mn\(_{38}\)Sb\(_{12-x}\)Si\(_x\) (\(x = 2.5, 3\)) ferromagnetic shape memory alloys

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Abstract

The data presented in this article is the supplementary data of Zhang et al. (2018) [1]. The Ni\(_{50}\)Mn\(_{38}\)Sb\(_{9}\)Si\(_{3}\) alloy is annealed at 1223 K for 24 h and then quenched into ice water; while the Ni\(_{50}\)Mn\(_{38}\)Sb\(_{9.5}\)Si\(_{2.5}\) alloy is annealed at 1173 K for 24 h and then quenched into ice water. The microstructure of the Ni\(_{50}\)Mn\(_{38}\)Sb\(_{9}\)Si\(_{3}\) alloy indicates that a higher heat treatment temperature cannot prevent the formation of secondary phases. Furthermore, the composition of \(\alpha\) phase is similar to the nominal composition of the alloy. On the other hand, the nominal concentration of Si atoms and heat-treatment temperature do not affect the compositions of the \(\beta\) and \(\gamma\) phases. For example, the compositions of the \(\beta\) and \(\gamma\) phases in the Ni\(_{50}\)Mn\(_{38}\)Sb\(_{9}\)Si\(_{3}\) alloy are similar when annealed at 1223 K for 24 h and 1173 K for 24 h.

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Specifications Table

| Subject area                        | Physics |
|-------------------------------------|---------|
| More specific subject area          | Materials Science |
Type of data: Tables, Figures
How data was acquired: SUPRA55 scanning electron microscope (SEM) equipped with an energy dispersive X-ray spectroscopy EDS
Data format: Raw, Analyzed
Experimental factors: Polycrystalline Ni$_{50}$Mn$_{38}$Sb$_{12-x}$Si$_x$ ($x=2.5, 3$) alloy ingots were prepared by vacuum induction melting under a high purity Ar atmosphere. The samples were re-melted two times in order to improve the compositional homogeneity. The ingot of Ni$_{50}$Mn$_{38}$Sb$_{9.5}$Si$_{2.5}$ alloy was annealed at 1173 K for 24 h, and then quenched into ice water. The ingot of Ni$_{50}$Mn$_{38}$Sb$_{9}$Si$_{3}$ alloy was annealed at 1223 K for 24 h, and then quenched into ice water.
Experimental features: The microstructure of Ni$_{50}$Mn$_{38}$Sb$_{9}$Si$_{3}$ alloys were observed by SEM. The compositions of the $\alpha$, $\beta$ and $\gamma$ phases in the Ni$_{50}$Mn$_{38}$Sb$_{9.5}$Si$_{2.5}$ and Ni$_{50}$Mn$_{38}$Sb$_{9}$Si$_{3}$ alloys were examined by SEM-EDS.
Data source location: Harbin, China
Data accessibility: The data are available with this article.

Value of the data

- This data fulfills the microstructure of Ni$_{50}$Mn$_{38}$Sb$_{9}$Si$_{3}$ alloy that was annealed at 1223 K for 24 h and then quenched into ice water.
- This data presents the compositions of $\alpha$, $\beta$ and $\gamma$ phases in Ni$_{50}$Mn$_{38}$Sb$_{9.5}$Si$_{2.5}$ and Ni$_{50}$Mn$_{38}$Sb$_{9}$Si$_{3}$ alloys, which were annealed at 1173 and 1223 K for 24 h, respectively, and then quenched into ice water.
- This data are useful in understanding the influence of the nominal concentration of Si atoms and heat-treatment temperature on the compositions of $\alpha$, $\beta$ and $\gamma$ phases in Si-doped Ni-Mn-Sb-Si alloys.

1. Data

The dataset of this article provides information on the microstructure of Ni$_{50}$Mn$_{38}$Sb$_{9}$Si$_{3}$ alloy annealed at higher temperature and the compositions of $\alpha$, $\beta$ and $\gamma$ phases in Ni$_{50}$Mn$_{38}$Sb$_{9.5}$Si$_{2.5}$ and Ni$_{50}$Mn$_{38}$Sb$_{9}$Si$_{3}$ ($x=2.5, 3$) alloys. Fig. 1 shows the microstructure of the Ni$_{50}$Mn$_{38}$Sb$_{9}$Si$_{3}$ alloy annealed at 1223 K for 24 h and then quenched into ice water. Table 1 shows the compositions of $\alpha$, $\beta$ and $\gamma$ phases in Ni$_{50}$Mn$_{38}$Sb$_{12-x}$Si$_x$ ($x=2.5, 3$) alloys at two different heat treatment conditions.

2. Experimental design, materials and methods

2.1. The microstructure of Ni$_{50}$Mn$_{38}$Sb$_{9}$Si$_{3}$ alloy and compositions of $\alpha$, $\beta$ and $\gamma$ phases in Ni$_{50}$Mn$_{38}$Sb$_{12-x}$Si$_x$ ($x=2.5, 3$) alloys

The heat treatment process of the Ni$_{50}$Mn$_{38}$Sb$_{12-x}$Si$_x$ ($x=2.5, 3$) alloys was similar to Ref. [2]. The as-cast ingots were placed in a quartz tube, evacuated and sealed using an oxygen-acetylene flame. Then the ingot of Ni$_{50}$Mn$_{38}$Sb$_{9.5}$Si$_{2.5}$ (NMSS2.5) alloy was annealed at 1173 K for 24 h, and then quenched into ice water. This alloy ingot was used to investigate the effect of Si content on the compositions of $\alpha$, $\beta$ and $\gamma$ phases. The ingot of Ni$_{50}$Mn$_{38}$Sb$_{9}$Si$_{3}$ (NMSS3) alloy was annealed at 1223 K for 24 h and then quenched into ice water, which was used to explore the effect of higher heat treatment temperature on the formation of the $\alpha$, $\beta$ and $\gamma$ phases. The compositions of $\alpha$, $\beta$ and $\gamma$ phases in Ni$_{50}$Mn$_{38}$Sb$_{12-x}$Si$_x$ ($x=2.5, 3$) alloys at two different heat treatment conditions were investigated and the influence of the nominal concentration of Si atoms and annealing temperature...
on the composition of $\alpha$, $\beta$ and $\gamma$ phases in Ni-Mn-Sb-Si alloys was revealed. Fig. 1 showed that higher heat treatment temperature could not prevent the formation of secondary phases ($\beta$, $\gamma$); however, the quantity of these secondary phases decreased obviously. Table 1 presented that the atomic content of $\alpha$, $\beta$ and $\gamma$ phases in NMSS2.5 and NMSS3 alloy obeyed the same trend as that in NMSS3 alloy, which has been discussed in the article. Additionally, the composition of the $\gamma$ phase seemed to be independent of the nominal concentration of Si atoms and the heat treatment temperature.

### Acknowledgements

RCZ, XXZ, MFQ and LG greatly acknowledge financial supports from the National Key R&D Program of China (Grant number 2017YFB0703103), National Natural Science Foundation of China (NSFC) (Grant number 51701052, 51001038) and the Ministry of Science and Technology Bureau of Harbin (Grant number 2011RFQXG001).

### Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.05.002.
References

[1] R.C. Zhang, X.X. Zhang, M.F. Qian, J.F. Sun, L. Geng, Effect of Si doping on microstructure and martensite transformation in Ni-Mn-Sb ferromagnetic shape memory alloys, Intermetallics 97 (2018) 1–7.

[2] R. Zhang, M. Qian, X. Zhang, F. Qin, L. Wei, D. Xing, X. Cui, J. Sun, L. Geng, H. Peng, Magnetocaloric effect with low magnetic hysteresis loss in ferromagnetic Ni-Mn-Sb-Si alloys, J. Magn. Magn. Mater. 428 (2017) 464–468.