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Review Report

PhD Thesis "Properties of Fe-Mn-Si and Ni-Ti shape memory alloys
prepared by pulsed-current sintering"
by Witold Prendota,
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Faculty of Physics and Applied Computer Science

1. Contents of the thesis

The thesis investigates the characterization and description of physical properties of Fe-Mn-Si and Ni-Ti alloys which exhibit shape memory effect.

Chapter 1 mentions the overview of the previously reported work on the shape memory materials, including physical properties, applications, preparation methods. In addition, the recent trends in the research and development of shape memory materials is described through the literature review. Further, pulsed-current sintering method used for materials preparation is described.

Chapter 2 explains briefly the measurement methods and experimental apparatus employed for materials characterization.

Chapter 3 shows the sample preparation process using pulsed-current sintering method. Focusing on Fe-Mn-Si type shape memory alloy prepared by pulsed-current sintering, its physical properties are also shown in this chapter.

In chapter 4, intended for Ni-Ti type shape memory alloy, a comparison of preparation process of diffusion couples generated by combined method of cold rolling and post thermal treatment with the pulsed-current sintering method is presented.

Chapter 5 focuses on the process of optimization with the application of pulse current sintering and its advantages to the combined method of cold rolling and thermal treatment, regarding micro-foil intermetallic production in one-step process. The measurement physical properties of Ni-Ti micro foils are shown in this chapter.

Chapter 6 concludes all achievements in the thesis.

2. Comments on the subject

Shape memory alloys are applied to wide range of industrial machinery, automobiles, home appliances, medical fields and so on. There are various types of shape memory alloys, and they are used for different applications according to their specific properties. Even for the same type of a shape memory alloy, the characteristics may differ depending on the manufacturing method. In order to make full use of the function of a shape memory alloy, it is important to understand its characteristics, and it is required to measure the basic physical properties for that purpose.

In the present study by the author, the target materials are Fe-Mn-Si and Ni-Ti alloys prepared by the pulsed-current sintering method. The typical applications of Fe-Mn-Si and Ni-Ti are constructions and micro-electro mechanical devices, respectively. The material selection meets the needs of the industrial sector. The author focuses on the characterization and description of physical properties of these materials. In addition, the effects of the composition and preparation conditions on the characteristics of these materials are matters of interest. The author's research results are valuable as fundamental knowledge and basic properties data of these materials.

3. Critical comments

1. Is it better to state the purpose of the research more clearly? It is better to explain what value the research results can have in the research and development of shape memory alloys.
2. Although the title of the thesis contains only alloy, the expression like "Ni-Ti shape memory compound" can be seen in the text. Is there a need to unify the designation of materials?

3. In this thesis, the measurement results of various types of physical properties are shown, and the basic characteristics of the material are clarified. This can be highly appreciated. However, the relationship between these physical property data and the function as a shape memory alloy is unclear. It is better to explain this point.
4. Since the object of research is shape memory alloy, it may be better to evaluate that the pulsed current sintering method is superior to other methods from the viewpoint of improving the function as a shape memory alloy.
5. In chapter 6, only the measurement results are described. In the conclusion section, it is necessary to describe what kind of result was obtained through the series of the research in correspondence with the purpose of the research.
6. I recommend the author to correct minor errors, such as typos and typographical errors, after checking the whole thesis.

4. General Opinions

As mentioned in the section 2, the subject of the thesis is regarded as an important issue in the research on shape memory materials. Based on the reviewing the previous research results of other researchers, the author properly set the objective of PhD work. The fundamental knowledge about the physical properties of Fe-Mn-Si and Ni-Ti shape memory alloys are not completely understood. In this thesis, through the measurement of their structure, magnetism, heat capacity, electrical conductivity and magneto-resistance, the basic physical properties are clarified. In addition, the effectiveness of pulsed-current sintering method is evaluated through the measurement of physical properties. The research results obtained from careful measurement are valuable for understanding the characteristics of shape memory materials. Overall, the author's achievement is above standard level.

5. Concluding remarks

As already explained, the thesis submitted to Faculty of Physics and Applied Computer Science in AGH-UST by Witold Prendota is interesting from a view-point of

material science and engineering of shape memory alloys. The results obtained through the measurement regarding the basic physical properties of Fe-Mn-Si and Ni-Ti shape memory alloys are useful for understanding the characteristics of shape memory alloys. I think that the research achievement by the author and submitted thesis are at enough level as PhD work. And therefore, I would like to recommend the faculty meeting at Faculty of Physics and Applied Computer Science, AGH-UST to proceed to a public (final) presentation with honors.

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