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Synthesis Of Nanocrystalline Nial By Mechanically Activated self-Propagating High Temperature Synthesis And Mechanically Activated Annealing Process

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Abstract

Nanotechnology, involves the production of a diverse array of nanomaterials (NM), which include nano-objects and nanoparticles (NP). Nanomaterials are generally defined as having one or more external dimensions or an internal or surface structure on the nanoscale (about 1–100 nm) [1].

The mechanically activated self-propagating high-temperature synthesis (MASHS) technique and the mechanically activated annealing process (M2AP) were used to produce NiAl intermetallic compound. The MASHS process results from the combination of two steps: first, a mechanical activation of the Ni + Al powders mixture; second, a self-propagating high-temperature synthesis (SHS). The M2AP process also results from the combination of two steps: the first is the same; the second consists of the annealing of as-milled powders.

Recently, mechanical activation of elemental powders prior to self-propagating high temperature synthesis (SHS) (mechanically activated SHS (MASHS)) has also been conducted [2–3]. Mechanically Activated Annealing Process (MA2P) has drawn wide interest in the synthesis of various alloys and compounds [4–6].

To identify the mechanically activated powders, MASHS and M2AP end-products, and to determine their microstructural characteristics, X-ray diffraction (XRD) analyses were performed. The characterization of the constituent phases was quantitatively evaluated using Rietveld whole profile fitting method adopting the most developed software MAUD well adopted to fit accurately the whole X-ray patterns [7–9] and optical micrographs.

Starting from a mixture of elemental pure powders, the first step M2AP or MASHS milling process leads to the formation of nanostructured powders in which between the initial elemental nickel and aluminum powders are formed. Structural analysis deduced from the Rietveld refinement of X-ray diffraction patterns of NiAl compounds milled for 8 h+ SHS or 8h+ AP show the formation of single phase β-NiAl ($a=0.2848\pm1.3.10^{-4}$) nm. Microstructural analysis has revealed the nanocrystalline character of MASHS or M2AP. The average crystallite sizes are of about (41.4651 ± 0.218) nm and the microstrains values are closed to those of metallic alloys ($0.3255 \pm1.2 .10^{-4}$ %).

References

[1] British Standards (BSI). Terminology for nanomaterials. Public Available Specification No. 1362007. London: British Standards Institution; 2007a. 16 pp.
[2] E. Gaffet, F. Bernard, Ann. Chim. Sci. Mater. 27 (6) (2002) 47–59.
[3] V. Gauthier, F. Bernard, E. Gaffet, D. Vrel, M. Gailhanou, J.P. Larpin, Intermetallics 10 (4) (2002) 377–389.
[4] G.H. Chen, J. Alloys Compd. 416 (2006) 279–283.
[5] E. Barraud, S. Begin-Colin, G. Le Caer, O. Barres and F. Villieras, Int. J. Nanotechnol. 5 (2008) 649–659.
[6] M.S. Archana, Neha Hebalkar, K. Radha and J. Joardar, J. Alloys Compd 501 (2010) 18–24.
[7] L. Lutterotti, MAUD, version 2.072, 2008.
[8] H.M. Rietveld, Acta Crystallogr. 22 (1967) 151.
[9] H.M. Rietveld, J. Appl. Cryslallogr. 2 (1967) 65.