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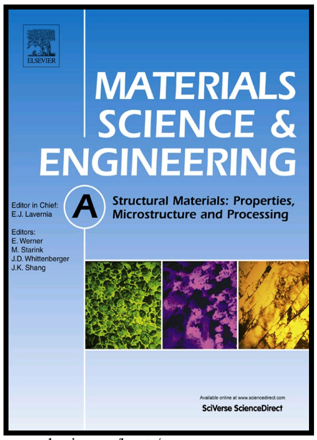

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Microstructure, mechanical and tribological properties of nickel-aluminium bronze alloys developed via gas-atomization and spark plasma sintering

Wenzheng Zhai, Wenlong Lu[1], Po Zhang, Mingzhuo Zhou, Xiaojun Liu, Liping Zhou

The State Key Laboratory of Digital Manufacturing Equipment and Technology, School of Mechanical Science and Engineering, Huazhong University of Science and Technology (HUST), Wuhan 430074, PR China

Abstract: This work investigated the effect of sintering temperatures (600-750 °C) on mechanical and tribological behaviors of nickel-aluminium bronze (NAB) alloys developed by gas atomization and spark plasma sintering. Results indicated an increase of the volume fraction of B2-type NiAl precipitates with increasing sintering temperature, leading to an improvement of the yield strength and the wear resistance. Specifically, detailed microstructural analyses of sintered NAB alloys at 750 °C showed the presence of ultrafine grains with an average size of 367 nm, nanoscale twins with a volume fraction of 11.7% and dislocations with a density of $1.3 \pm 0.1 \times 10^{14}$ m^{-2}. A much higher yield strength of 620 MPa was obtained in NAB, if compared to that of conventional cast counterparts (280-440 MPa). Estimations of strengthening mechanisms suggested the predominant mechanism of grain boundary strengthening (335MPa) for NAB alloys with contributions from precipitate strengthening (54 MPa), dislocation strengthening (75 MPa), twin boundary strengthening (89 MPa) and solid solution strengthening (50 MPa). Moreover, dislocations was blocked at twin boundaries to form complex dislocation barriers and networks, further contributing to the high strength. The high wear resistance of NAB could be ascribed to the reduction of the local stress around crack tips due to the high elastic modulus mismatch (E_{NiAl}/E_{Cu}), and to the crack extension toughening near the interface of the matrix and the precipitate caused by the high plastic mismatch ($\sigma_{NiAl}/\sigma_{Cu}$).

Keywords: Characterization; Copper alloys; Powder methods; Grains and interfaces

[1] Corresponding author.
E-mail addresses: hustwenlong@mail.hust.edu.cn (W.L. Lu)