

Characterization of Rapidly Solidified Ni-Nb-Sn Alloys

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The continuous interest in Bulk metallic glasses (BMG) is explained by their exceptional physical and chemical properties such as wear and corrosion resistance and its peculiar mechanical behaviour during processing. Ternary alloys of $\text{Ni}_{60}\text{Nb}_{40-x}\text{Sn}_x$ ($3 \leq x < 9$) (at. %) were found to form BMGs and showed high compressive yield strength, for example between 1,8 and 2,8 GPa [1,2]. However, BMGs are currently obtained as ribbons, powders or wires, therefore, application for these alloys is limited. The objective of this work was the production and characterization of ternary alloys Ni-Nb-Sn (powders and bulk) and its use in coatings produced by Laser Cladding on low carbon steel substrate. Nitrogen gas atomized powders with varied morphology were sieved in various size ranges. Bulk samples were also obtained during atomization through spray forming processing. Laser Cladding was used to fabricate the coatings with variable speed and power. The coatings and overspray powders were characterized by optical microscopy (OM), scanning electron microscopy (SEM), X-ray diffraction (XRD) and measurements of Vickers microhardness. All coatings demonstrated dendritic microstructure near to the substrate and high dilution between coating and substrate. The XRD pattern for the coatings lead to the identification of Ni_3Nb and Ni_6Nb_7 as primary cristalization phases. Coatings showed a very high Vickers microhardness ranging from 800 to 1200 HV. In another set of experiments alloys with composition $\text{Ni}_{60}\text{Nb}_{33}\text{Sn}_7$ and $\text{Ni}_{62}\text{Nb}_{31}\text{Sn}_7$ (at. %) were suction copper mold cast (SMC) in plate shape (0,5 and 1mm in thickness). Then, were characterized by SEM, XRD and measurements of Vickers microhardness. Both samples with 1mm thickness showed peaks of crystallinity phases Ni_3Nb and Ni_6Nb_7 , however, with very refined microstructure. On the other hand, only the $\text{Ni}_{60}\text{Nb}_{33}\text{Sn}_7$ (at. %) showed the XRD with characteristic curve of amorphous, for the samples with 0,5mm. These suction cast materials showed Vickers microhardness of 975.5 ± 30.5 (for 1mm) and 844 ± 19.1 (0,5mm) for $\text{Ni}_{60}\text{Nb}_{33}\text{Sn}_7$, 865.4 ± 14.4 (1mm) and 846.4 ± 12.9 (0.5mm) for $\text{Ni}_{62}\text{Nb}_{31}\text{Sn}_7$. !

Keywords: Ni-based alloy, amorphous coating, spray forming, BMG, hardfacing, laser cladding. !

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