



Contents lists available at ScienceDirect

Journal of Alloys and Compounds

journal homepage: www.elsevier.com/locate/jalcom

Microstructure and mechanical properties of $\text{Al}_{0.44}\text{Si}_{0.32}\text{Ni}_{0.09}\text{Fe}_{0.05}\text{V}_{0.05}$ alloy containing nanosilica for vehicle bonnet applications

Sefiu Adekunle Bello^{a,*}, Maruf Yinka Kolawole^b, Raphael Gboyega Adeyemo^c,
Funsho Olaitan Kolawole^d, Uthman Ayomide Aliu^a, Ayodeji Aboyeji^a, Ahmed Rafiu^a,
Abdul Ganiyu Funsho Alabi^a, Oyetunji Akinlabi^e

^a Department of Materials Science and Engineering, Kwara State University, Malete, Nigeria

^b Department of Mechanical Engineering, Kwara State University, Malete, Nigeria

^c The Gateway (ICT) Polytechnic, Sapele, Ogun, Nigeria

^d National Institute for Space Research, Associated Laboratory of Sensors, and Materials, Av dos Astronautas 1758, São José dos Campos, SP 12227-010, Brazil

^e Department of Materials and Metallurgical Engineering, Federal University of Technology, Akure, Ondo, Nigeria

ARTICLE INFO

Keywords:

Nanosilica modified
Husler alloy
Multicomponent
Bonnet
Properties
Tensile strength optimisation

ABSTRACT

Stringent conditions of service that demand improved properties spurs continuous research on expired products to emerge new materials for engineering applications. An alloy was developed from aluminium scraps, ferro-silicon, and nickel alloy. The developed alloy was modified by nanosilica and the produced materials were examined. Result displays silica having an average size of 63.76 nm. In addition, new phases were detected in the alloys due to nanosilica additions and heat treatment. Moreover, the threadlike grain boundary phases of the control alloy changed to rounded tiny particles after the heat treatment. Silica addition to the alloy caused refinements of grains leading to numerous grain boundaries while the grain boundary phases of the heat treated nanosilica modified alloy appear in form of a modulated featherlike structure. An improvement in tensile strength was noted up to 10 wt% of nanosilica additions. Reduction in the impact energy prevails above 6 wt% of nanosilica addition. Heat treatment enhanced tensile properties and impact energies but reduced the hardness values of the developed alloys. Moreso, linear response surface models are significant in predicting the tensile strengths of the developed alloys. Model diagnostics like outlier and Cook's distance confirm no error in the models. Comparison of properties affirm that tensile strength, tensile strain, and impact energy of the heat treated $\text{Al}_{0.44}\text{Si}_{0.32}\text{Ni}_{0.09}\text{Fe}_{0.05}\text{V}_{0.05}$ alloy containing 10 wt% of nanosilica are greater than those of the LEXUS LX570 (2018 model), TOYOTA HILUX (2017 model), and TOYOTA CAMRY (2018 model). Hence, it is a strong, ductile, tough, and less hard material for the bonnet applications.