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Characterizing the effects of SiC and Al_2O_3 on the mechanical properties of Al6082 hybrid metal matrix composites: An experimental and neural network approach

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ABSTRACT

The use of advanced materials in the field of aerospace and automotive applications has led to use of metal matrix composites (MMC's) due to their excellent mechanical properties. Aluminium metal matrix composite is one of the materials which can be strengthened by reinforcing it with hard ceramic particles. In the current work Al6082 matrix hybrid composites reinforced with silicon carbide (SiC) and aluminium oxide (Al2O3) was developed by using stir casting technique. The weight percentage of SiC was varied from 0 wt.% to 8 wt.% and keeping 3 wt.% Al2O3 constants. The tensile, hardness, density and impact tests were conducted, and the results obtained revealed that the addition of silicon carbide and Al2O3 particles in Al6082 enhances the mechanical properties of the prepared hybrid composites. The artificial neural network (ANN) model, which was trained using a dataset consisting of experimental results, has effectively captured the correlation between the weight percentage (wt.%) of silicon carbide (SiC) and the mechanical properties of the composite material. Through the examination of this model, valuable insights can be obtained regarding the distinct contributions of SiC to the mechanical properties of Al6082.

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Izvirni znanstveni članek

Določitev vplivov SiC in Al_2O_3 na mehanske lastnosti hibridnih kompozitov s kovinsko matrico Al6082: Eksperimentalni pristop in pristop z nevronsko mrežo

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POVZETEK

Uporaba naprednih materialov v letalski in avtomobilski industriji je zaradi odličnih mehanskih lastnosti pripeljala do uporabe kompozitov s kovinsko matrico. Aluminijasti kompozit s kovinsko matrico je eden od materialov, ki se lahko ojača s trdimi keramičnimi delci. V pričujočem delu je bil s tehniko mešalnega litja razvit hibridni kompozit z matriko Al6082, ojačan s silicijevim karbidom (SiC) in aluminijevim oksidom (Al_2O_3). Masni delež SiC se je spreminjal od 0 % do 8 %, pri čemer je bila konstanta 3 % Al_2O_3. Izvedeni so bili natezni, trdnostni, udarni preskusi in preizkusi gostote, dobljeni rezultati pa so pokazali, da dodatek delcev silicijevega karbida in Al_2O_3 v Al6082 izboljša mehanske lastnosti pripravljenih hibridnih kompozitov. Model umetne nevronske mreže (ANN), ki je bil naučen z uporabo nabora podatkov, sestavljenega iz eksperimentalnih rezultatov, je učinkovito opisal korelacijo med masnim deležem silicijevega karbida (SiC) in mehanskimi lastnostmi kompozitnega materiala. S preverjanjem tega modela je mogoče pridobiti dragocen vpogled v različne prispevke SiC k mehanskim lastnostim kompozita Al6082.

PODATKI O ČLANKU

Ključne besede:
Letalska in avtomobilska industrija;
Proizvodnja;
Mešalno litje;
Kompoziti s kovinsko matrico;
Aluminijasti kompozit s kovinsko matrico (Al2O3);
Silicijev karbid (SiC);
Mehanske lastnosti;
Umetna nevronska mreža (ANN)

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