Accepted Manuscript

Design of a nickel-base superalloy using a neural network

B.D. Conduit, N.G. Jones, H.J. Stone, G.J. Conduit

PII: S0264-1275(17)30590-7
DOI: doi:10.1016/j.matdes.2017.06.007
Reference: JMADE 3125

To appear in:

Received date: 16 April 2017
Revised date: 17 May 2017
Accepted date: 3 June 2017

Please cite this article as: B.D. Conduit, N.G. Jones, H.J. Stone, G.J. Conduit, Design of a nickel-base superalloy using a neural network, (2017), doi:10.1016/j.matdes.2017.06.007

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.
Design of a nickel-base superalloy using a neural network

B.D. Conduit
Rolls-Royce plc, PO Box 31, Derby, DE24 8BJ, United Kingdom

N.G. Jones
Rolls-Royce UTC, 27 Charles Babbage Road, Cambridge, CB3 0FS, United Kingdom

H.J. Stone
Rolls-Royce UTC, 27 Charles Babbage Road, Cambridge, CB3 0FS, United Kingdom

G.J. Conduit
Cavendish Laboratory, J.J. Thomson Avenue, Cambridge, CB3 0HE, United Kingdom

Abstract

A new computational tool has been developed to model, discover, and optimize new alloys that simultaneously satisfy up to eleven physical criteria. An artificial neural network is trained from pre-existing materials data that enables the prediction of individual material properties both as a function of composition and heat treatment routine, which allows it to optimize the material properties to search for the material with properties most likely to exceed a target criteria. We design a new polycrystalline nickel-base superalloy with the optimal combination of cost, density, γ′ phase content and solvus, phase stability, fatigue life, yield stress, ultimate tensile strength, stress rupture, oxidation resistance, and tensile elongation. Experimental data demonstrates that the proposed alloy fulfills the computational predictions, possessing multiple physical properties, particularly oxidation resistance and yield stress, that exceed existing commercially available alloys.

Keywords: Neural network; materials design; nickel-base superalloy

Despite the central importance of materials in enabling new technologies, historically the only way to develop new materials has been through experiment driven trial and improvement [1]. This means that commercially available alloys are the result of many years of empirical development, and whilst they have good properties, they do not necessarily offer the right balance of properties needed for specific engineering applications. The capability to discover materials computationally has the potential to empower engineers to utilize materials optimized for their application [2]. The development of new algorithms
دریافت فوری متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات