# Conference of the South African Advanced Materials Initiative (CoSAAMI-2018)

IOP Conference Series: Materials Science and Engineering Volume 430

Vanderbijlpark, South Africa 23 - 26 October 2018

**Editors:** 

Silethelwe Chikosha Ronald Machaka

ISBN: 978-1-5108-7338-4 ISSN: 1757-8981 Printed from e-media with permission by:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2018) by the Institute of Physics All rights reserved. The material featured in this book is subject to IOP copyright protection, unless otherwise indicated.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact the Institute of Physics at the address below.

Institute of Physics Dirac House, Temple Back Bristol BS1 6BE UK

Phone: 44 1 17 929 7481 Fax: 44 1 17 920 0979

techtracking@iop.org

#### Additional copies of this publication are available from:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571 USA Phone: 845-758-0400 Fax: 845-758-2633 Email: curran@proceedings.com Web: www.proceedings.com

## **Table of contents**

### Volume 430

**Conference of the South African Advanced Materials Initiative (CoSAAMI-2018)** 

23-26 October 2018, Vanderbijlpark, South Africa

Accepted papers received: 17 September 2018 Published online: 2 October 2018

Preface

Conference of the South African Advanced Materials Initiative (CoSAAMI-2018)

Foreword

The Committees of the 2018 Conference of the South African Advanced Materials Initiative (COSAAMI-2018)

Peer review statement

Papers

Composites

Metal matrix composite laser metal deposition for ballistic application

R Adam, A Botes and G Corderley.....1

Effect of milling parameters on the dispersion characteristics of multi-walled carbon nanotubes in transition metal oxides

S S Lephuthing, A M Okoro, M Lesufi, O O Ige and P A Olubambi.....8

Evaluating extrudability of particle-reinforced 2124-Al MMCs and MMNCs within the warm working temperature range (170-280°C)

Zizo Gxowa, Lesley H. Chown and Gonasagren Govender....15

Structural integrity and dispersion characteristics of carbon nanotubes in titanium-based alloy

A M Okoro, R Machaka, S S Lephuthing, M Awotunde and P A Olubambi.....22

#### Materials for extreme environments

Batch adsorption study of uranium on various ion exchange resins as an alternative method to solvent extraction

J S Gama, J Barry and P L Crouse.....29

Concentration of rare earth elements from monazite by selective precipitation

S M Xaba, M Nete and W Purcell.....36

#### Titanium

Research and Development of Ti and Ti alloys: Past, present and future

Kalenda Mutombo.....43

Development status of the CSIR-Ti Process

S J Oosthuizen and J J Swanepoel.....49

#### Machining-Titanium

Manufacturing of high added value titanium components. A South African perspective

D Dimitrov, E Uheida, G Oosthuizen, D Blaine, R Laubscher, A Sterzing, P Blau, W Gerber and O F R A Damm.....58

#### Welding-Titanium

Development and Process Verification of a Linear Friction Welding Platform for Small Axis-Symmetrical Ti6Al4V Components

N T A Mohlala, D G Hattingh and W Rall.....68

#### Welding-Aluminium

Development of a welding platform and tool for the study of weld and process parameters, during continuous friction stir welding of AA6082-T6 sheets

P P Chikamhi, D G Hattingh and B Dreyer.....74

#### Welding-Titanium

Process optimization of rotary friction welding of Ti-6Al-4V alloy rods

MC Zulu and PM Mashinini.....81

On Machinability of Titanium Grade 4 under Minimum Quantity Lubrication Assisted High Speed Machining

T N Mathonsi, R F Laubscher and K Gupta.....87

#### Machining-Titanium

A study of the machinability of Ti-6Al-4V compacted powders

M T Tambani, C Machio, D M Madyira, E H Uheida and G A Oosthuizen.....93

#### **Mechanical testing-Titanium**

The effect of specimen geometry on tensile properties of titanium alloy metal sheet.

M S Masete, N S Muchavi and S Chikosha.....98

#### **Modelling-Computational**

Interatomic potential parameters for Li-Cl-Ti interaction

A F Mazibuko, H R Chauke, P E Ngoepe and C R A Catlow.....103

Computational chemistry study of zirconium monomers in low acid concentration aqueous solutions

D B Jansen van Vuuren, H M Krieg and C G C E van Sittert.....109

Thermodynamic stability of doped FeAl-X (X = Pd, Ag, Pt and Ru) systems

C S Mkhonto, H R Chauke and P E Ngoepe.....115

Mechanical properties and stability of TiPt-M (M = Ru, Co, Cu, Zr and Hf) for high temperature applications

M P Mashamaite, H R Chauke and P E Ngoepe.....122

#### **Modelling-Smart Materials**

Computational study of binary titanium-based potential shape memory alloys

M E Baloyi, R Modiba, H R Chauke and P E Ngoepe.....128

Computational modelling of Ti<sub>50</sub>Pt 50-XVx potential shape memory alloys

R Modiba, E Baloyi, S Chikosha, H R Chauke and P E Ngoepe.....133

#### Alloy development

The effect of vanadium on structure and martensitic transformation temperature of TiPt alloy

S Chikosha, M L Mahlatji, R Modiba and H K Chikwanda.....138

Phase analyses of the Co-Fe-Pd ternary alloys

K Dyal Ukabhai, I A Mwamba and L A Cornish.....145

#### **Modelling-Simulation**

Finite-element analysis of the effect of sheath-gas composition in an inductively-coupled plasma

N J M Grobler, H Bissett, G J Puts and P L Crouse.....151

#### **Modelling-Numerical**

Numerical simulation of plastic deformation and mechanical response of strip rolled aluminium alloys

G J Jansen van Rensburg and A E J Bogaers.....158

#### **Powder metallurgy**

Determination of roll compaction parameters required for high green density, defect free Ti-6Al-4V strips

N S Muchavi, S Chikosha, H K Chikwanda and E M Makhatha.....165

#### **Casting - aluminium**

Characterization of A356 investment cast component produced using controlled liquid metal cooling technique

TF Sishuba, P Rossouw, U Curle and K Mutombo.....172

#### Additive manufacturing - aluminium

The effect of selective laser melting build orientation on the mechanical properties of AlSi10Mg parts

B J Mfusi, L C Tshabalala, A P I Popoola and N R Mathe.....178

#### **Powder metallurgy - milling**

Development and characterization of nanocrystalline cobalt powder prepared via high energy ball milling process

A L Rominiyi, M B Shongwe and B J Babalola.....185

#### **Powder metallurgy - mechanical alloying**

Effect of milling speed on the formation of Ti-6Al-4V via mechanical alloying

P Daswa, Z Gxowa, MJI Monareng and K Mutombo.....191

#### **Powder metallurgy**

<u>A comparative study of oxygen pick-up of TiHDH powder during press and sinter and loose sintering processing</u>

T M Motsai, S Chikosha, C Machio and M E Makhatha.....196

Exploring Micro-focus X-ray computed tomography for metal injection moulded green parts

M Seerane.....202

Metal injection moulding of a 17-4 PH stainless steel: a comparative study of mechanical properties

Ronald Machaka.....208

Densification behavior of spark plasma sintered duplex stainless steel reinforced with TiN nanoparticles

S R Oke, O O Ige, O E Falodun, M R. Mphahlele and PA Olubambi.....214

Spark plasma sintered Ti6Al4V-ZrO2 bio-composites: optimization of ball milling and turbula mixing of powders and their subsequent sintering parameters

N A Moshokoa, T V Mukhudwana, L M Raganya, J I Lekgoathi, B A Obadele and P A Olubambi.....220

#### Corrosion

Cytocompatibility evaluation of nano-sintered Ti-15Zr-4Nb-2Ta-0.2Pd alloy produced by spark plasma sintering technique

Annastasia Mantshiu, Wallace Matizamhuka, Akiko Yamamoto, Brendon Shongwe and Ronald Machaka.....227

Sintering Performance and Corrosion behavior of biomedical Ti-24Nb-4Zr-8Sn alloy produced using SPS in various simulated body solutions

J Madonsela, W Matizamhuka, R Machaka, B Shongwe and A Yamamoto.....234

Investigation of abnormal corrosion of 10.5 – 12.5 chromium ferritic stainless steel used to fabricate railway coal wagons

T C Mamphekgo, V J Matjeke and K Pillay.....240

Investigation of corrosion behaviour of carbon steel in simulated soil solution from anodic component of polarisation curve

Phumlani Mjwana, Mandla Mahlobo, Obadele Babatunde, Philippe Refait and Peter Olubambi.....248

Flow-induced corrosion behaviour of low alloy steel in the presence of mono-ethylene glycol

Sunday Aribo, Mantsha Sesheweni, Olufemi Sanumi, Adekunle Ogunbadejo, Oladeji Ige and Peter Apata Olubambi.....255

A comparative corrosion study of titanium strips produced by wrought and direct powder rolling processes

N Mothopeng, N Maledi, M Maminza and S Chikosha.....260

#### Heat treatment

The direct observation of surface martensite formation upon cooling to temperatures close to ambient in a heat treated AISI 301 stainless steel

T W Mukarati, R J Mostert and C W Siyasiya.....266

Effect of putrefied quenching oil on the transformation behaviour of railway spring steel.

V.J. Matjeke, G. Mukwevho and J.W. van der Merwe.....273

Effect of heat treatment on strength and ductility of 52CrMoV4 spring steel.

VJ Matjeke, G Mukwevho, AM Maleka and JW van der Merwe.....280

The influence of full and partial austenitization temperatures on the quench and partition heat treatment process for an advanced high strength steel

V Kurup, C W Siyasiya, R J Mostert and J Wicks.....287

#### **Polymer composites**

Evaluation of machining performance of pineapple filler based reinforced polymer composites using abrasive water jet machining process

Jagadish, Kapil Gupta and Maran Rajakumaran.....297

Synthesis of a Novel Amphiphilic Nano-Chitosan Material

W M R Matshe, L Tshweu and M O Balogun.....304

Synthesis, characterization and antimicrobial activities of quaternary chitosan-based materials

Zamani Cele, Lindokuhle Ndlandla, Anou Somboro, Daniel Gyamfi and Mohammed Balogun.....311

#### **Ceramic Coating**

Synthesis and Characterization of Tantalum Oxide Deposited By Metal-Organic Chemical Vapour Deposition (MOCVD)

S O Jeje, O O Akinwunmi and M B Shongwe.....317