



FUNCTIONAL MATERIALS: PROCESSING, UTILISATION, PROTECTION

EDITED BY
PROF. VADIM V. KORABLEV
DR. THANGAPRAKASH SENGODAN
PROF. DR. RAMADHANSYAH PUTRA JAYA
DR. SUWARNO SUWARNO
PROF. DR. JAV DAVAASAMBUU



TRANS TECH PUBLICATIONS

Functional Materials: Processing, Utilisation, Protection

Edited by
Prof. Vadim V. Korablev
Dr. Thangaprakash Sengodan
Prof. Dr. Ramadhansyah Putra Jaya
Dr. Suwarno Suwarno
Prof. Dr. Jav Davaasambu

Functional Materials: Processing, Utilisation, Protection

Special topic volume with invited peer-reviewed papers only

Edited by

**Prof. Vadim V. Korablev, Dr. Thangaprakash Sengodan,
Prof. Dr. Ramadhansyah Putra Jaya,
Dr. Suwarno Suwarno and Prof. Dr. Jav Davaasambuu**

■ **Scientific.Net** ■

Copyright © 2023 Trans Tech Publications Ltd, Switzerland

All rights reserved. No part of the contents of this publication may be reproduced or transmitted in any form or by any means without the written permission of the publisher.

Trans Tech Publications Ltd
Seestrasse 24c
CH-8806 Baech
Switzerland
<https://www.scientific.net>

Volume 943 of
Key Engineering Materials
ISSN print 1013-9826
ISSN web 1662-9795

Full text available online at <https://www.scientific.net>

Distributed worldwide by

Trans Tech Publications Ltd
Seestrasse 24c
CH-8806 Baech
Switzerland

Phone: +41 (44) 922 10 22
e-mail: sales@scientific.net

Preface

This book collects articles based on the results of scientific and engineering research in applied materials science and technologies of materials treatment.

The first two parts include research on metal surface treatment technologies to improve their functional characteristics and specific features of friction welding technologies in modern machine building.

The corrosion behaviour of structural materials and corrosion protection methods with bio inhibitors and protective coatings are analysed in the next two parts of the book. Here is also presented the research on the hydrogen compatibility of structural materials that is today the actual issue in the area of the energy transition.

Properties of functional ceramics, glasses and perspective materials for micro- and optoelectronics are investigated and analysed in the fifth and sixth chapters.

The last part of the book is devoted to researching the application of cement replacement materials - a modern trend in the spirit of sustainability in the construction industry.

This special edition will be helpful to specialists in machinery, micro- and optoelectronics and construction.

Table of Contents

Preface

Chapter 1: Treatment of Structural Metals

Surface Alloying of Tool Steels with Ytterbium Pulse Fiber Laser A. Lupsanov, S. Lysykh, S. Bronnikova, D. Dasheev, U. Mishigdorzhyn, A.V. Nomoev, N. Ulakhanov and I. Yuzhakov	3
Structure Hardness and Elastic Modulus of Ti-Nb-Y Alloys B. Bolormaa and M. Dovchinvanhig	13
Modelling and Optimization of Amphoteric Surfactant Concentration in Electroless Nickel Boron Coatings for Maximum Microhardness M. Vijayanand, R. Varahamoorthi, P. Kumaradhas and S. Sivamani	19

Chapter 2: Friction Welding

Friction Stir Welding Process Optimization on 4 Tool pin Geometries with Process Parameters and Shoulder Concave Angle in 6005A-T6 Aluminium Alloy Joining N.A. Pontjonoto, I.M.L. Batan, A.S. Pramono, A. Wahjudi and Mulyadi	33
Macrostructure and Shear Strength Analysis on Cu-Al Joint of Micro Friction Stir Spot Welding H. Muzakki, I. Millaily, Ahmadi, Suwarsono and J.S. Bale	41
Influence of Tool Rotation and Surface Roughness on the Shear Strength of Nylon 6 - SS 304 Dissimilar Joint Resulted by Friction Lap Welding W. Wahono, I. Arnanda, A. Suyetno, A. Aminnudin, A.S. Ansari and Y.R.A. Pradana	47
The Influence of the Tool Concave Shoulder Angle on Heat Generation in the Stir Friction Welding Process with AA6061-T651 Materials Mulyadi, A.S. Pramono, A. Wahjudi, I.M.L. Batan and N.A. Pontjonoto	55

Chapter 3: Corrosion Behaviour and Hydrogen Embrittlement of Materials

Features of Crevice Corrosion of Different Grades of Duplex Stainless Steels A.S. Fedorov, V. Karasev and P. Kovalev	65
Analysis of Causes of Corrosion Damage to Internal Surface of Stainless Steel Heat Exchanger Tubes J.S. Karzina and O.V. Shvetsov	71
Criteria for Revaluating the Propensity of Metals to Corrosion Cracking during Accelerated Testing in an Environment with Hydrogen Sulfide and Carbon Dioxide O.V. Shvetsov, S. Kondratev, A. Kharkov, A.A. Alkhimenko and A.D. Davydov	79
Technological Support for Evaluation of Hydrogen Compatibility of Materials in Laboratory Conditions A.S. Tsvetkov, N.O. Shaposhnikov, V.A. Yakhimovich, M.K. Kurakin and A.A. Lapechenkov	85
Physical Modeling of Steel Resistance to Hydrogen Embrittlement N.O. Shaposhnikov, A.S. Tsvetkov, D.A. Strekalovskaya, A. Nikolaeva and N.A. Devyaterikova	91
Analysis of the effect of Zea Mays husk particulate reinforcement on 1170 Aluminium corrosion in a simulated industrial environment W.A. Joseph, R.T. Loto, P. Babalola and J. Okeniyi	97

Chapter 4: Corrosion Protection

Mild Steel Corrosion Inhibition by <i>Andrographis paniculata</i> Leaves Extract in 10 % Hydrochloric Acid Solution N.M.I. Alhaji and S. Sujatha	111
Study of Green Corrosion Inhibitor of <i>Aegle marmelos</i> Leaves Extract in Acidic Medium V.V. Sravanth, S.L. Avapati, V.R. Poiba and M. Vangalapati	117
Comparative Evaluation of the Protection Performance of Admixed Tea Tree and Grapefruit Essential Oil Extracts on Mild Steel and Alloy Steel 3310 O. Osamudiamé, A.C. Nissi, O.O. Oluwakayode, U.V. Oghoho, O.C. Daniel, I.P. Smart, P.A.C. Lemuel, O.R. Nwabeze and R.T. Loto	127
Evaluation of Protective Properties of Lacquer Coatings on Copper Products Operating in a Low Aggressive Corrosive Environment A.D. Davydov, M. Kovalev and D. Lyashenko	135

Chapter 5: Glasses and Functional Ceramics

CoAl₂O₄ Spinel Growth on SiO₂ Substrates via Annealing of Magnetron Sputtered Thin Films I.A. Ereemeev, D.V. Honcharenko and A.V. Semenchá	145
Reproducibility of Properties of As_xSe_{1-x} Glasses on the Synthesis Temperature M.E. Samigullin, A.V. Belykh, N.I. Krylov, M.D. Mikhailov and A.V. Semenchá	151
Influence of the Type and Concentration of the Dopant on the Photocatalytic Activity of Strontium Bismuthate Sr₂Bi₂O₅ D.S. Shtarev, E.A. Kirichenko, A.V. Shtareva, A.J. Petrova, V.O. Krutikova and I.A. Astapov	157
The Synthesis Regimes Effect on Powders and Ceramics of MgAl₂O₄ Doped with Cr³⁺ E. Afanaseva, E. Vaishlia, V.A. Klinkov and I. Kolesnikov	165

Chapter 6: Materials for Electronics and Optoelectronics

Thermal Annealing Effects on the Raman and Photoluminescence Properties of Mono and Few-Layer MoS₂ Films G. Munkhbayar, É. Nomin-Erdene and J. Davaasambuu	173
Preparation, Structure, and Photophysical Behavior of Europium (III) Complexes of Decyl Alanine and Lauryl Alanine J. Han, N. Gerile, Y. Zhang, Y.F. Shi, B. Altan and O. Tegus	179

Chapter 7: Cement Replacement Materials

Utilization of Magnesium-Rich Synthetic Gypsum as Partial Replacement Material in Concrete H.M. Noh, N.L.I.A. Mohamad, N.A. Idris, N. Kasim, R. Zainal and S.M.S. Musa	191
Properties of Self-Compacting Concrete Containing Palm Oil Fuel Ash and Rice Husk Ash A.N. Rizalman, M.K.M. Bisi, S.M.S.A. Razak and M.E. Mohamad	201
Enhancement of Autogenous Healing on Pre-Cracked PFA Concrete Using Response Surface Methodology (RSM) M.F. Md Jaafar, N. Ghazali, K.A. Shahid, R. Zailan, K. Muthusamy and F.M. Yahaya	213
Characterization and Strength Activity Index of Eggshell Powder and Silica Fume as Partial Cement Replacement A.N. Rizalman and B. Sibin	225
Effect of Mixing Anadara Granosa Shells Ash and Fly Ash as a Cement Replacement on Foamed Concrete Properties S.Z. Keumala Citra, Wahyuni, Munawir, R.F. Vito and T.I. Rais	233