Emerging Materials Research
Volume 4 Issue EMR2
Editorial
Ravindra

ice | science

Emerging Materials Research
December 2015 Issue EMR2
Pages 253–254 http://dx.doi.org/10.1680/jemmr.2015.4.2.253

ice
Institution of Civil Engineers
publishing

Editorial

Nuggehalli M. Ravindra PhD
New Jersey Institute of Technology, Newark, NJ, USA

The Materials Science & Technology 2015 (MS&T 2015) Technical Meeting and Exhibition was held in Columbus, OH, USA on 4–8th October 2015 (see http://matscitech.org). The conference was sponsored by five of the leading materials engineering societies in the world (ACerS, American Ceramic Society; AIST, Association for Iron & Steel Technology; ASM International, formerly known the American Society for Metals; TMS, The Minerals Metals Materials Society; and NACE International, formerly known as the National Association for Corrosion Engineers) and hosted over 2000 presentations and a large number of parallel sessions.

The symposium on 'Additive Manufacturing' was one of the major highlights of MS&T 2015. The sessions in this symposium focused on issues related to a variety of problems, including additive manufacturing of metals, in-situ process monitoring and control, materials science of additive manufacturing and novel materials and process development for additive manufacturing. In recent years, 3D printing is increasingly being used as a synonym for additive manufacturing (see http://www.eos.info/en). Coupled with rapid prototyping, this technology will lead to new opportunities in various sectors of the industry. Specific examples of these include the successful production of the GEnx jet engine (see http://www.ge.com/stories/advanced-manufacturing) using an advanced 3D-printing technique in the form of direct metal laser melting. Today, 3D printing is viewed as an enabling technology (see http://www.stratasys.com/solutions). From the materials point of view, it is anticipated that metals will continue to be the prime driver of 3D printing. Innovation has already begun to result from the use of 3D printing in aerospace, automotive, defense and medicine-related applications. Specific examples of the 3D printing in medicine include the following: 3D bioprinting of tissues and organs,[1,2] personalized heart models for surgical planning[3] and a 3D-printed prescription pill Spritam[4] for use by adults and children who suffer from certain types of seizures caused by epilepsy.

With the evolving new manufacturing methods, the role of modeling and simulation of materials, material processes, material properties and material performance has become extremely important. Such modeling and simulation tools facilitate the assessment of return on investment as well as the efficiency and yield of new manufacturing methods. In order to better understand the role of materials in society, investments in materials-related education are essential. An example of global efforts in materials education is the work of Michael Ashby of Cambridge University (see https://www-edc.eng.cam.ac.uk/people/mfa2.html), in collaboration with Granta Design (see http://www.grantadesign.com). By organizing the Materials Education Symposia (see http://www.materials-education.com) in North America, Europe and Asia, educators gather to discuss the present and future challenges of education in materials science and engineering.

The next paper in this issue of *Emerging Materials Research* presents a study on 'The microstructure, tensile response and fracture behavior of a high-performance structural steel: influence of orientation'.[5] The present one is a collaborative study by S. Gowda, C. Hotz and A. Patnaik of the Department of Civil Engineering, and K. Manigandan and T. S. Srivatsan of the Department of Mechanical Engineering, both at the University of Akron, OH, USA. In this study, the microstructure, hardness, tensile deformation and fracture behavior of a structural steel (ASTM A572-Grade 50) are presented and discussed. Specifically, the influence of test specimen orientation on the microstructure of the as-provided material and the resultant influence of microstructure on hardness, tensile properties and final fracture behavior are examined. In addition, aspects related to the macroscopic mode and the governing intrinsic microscopic features that result from fracture of the steel specimens, machined from the two orientations (longitudinal and transverse), are also examined. The microscopic mechanisms governing quasi-static deformation and final fracture behavior of these structural steels are discussed in light of the conjoint influence of test specimen orientation, intrinsic microstructural effects and nature of loading.

The paper by F. Wang, B. Hou, K. Yuan and Y. Wang of the School of Mechanical Engineering, Dalian University of Technology, Dalian, P. R. China, focuses on the 'Compactness of coatings treated by MAO and LSM on Ti alloy'.[6] Microarc oxidation (MAO) coatings exhibit loose surfaces, big micropores and porosity that lead to shortcomings in their mechanical properties. Three kinds of MAO coatings were prepared on TC4 alloys (Ti–6Al–4V) in electrolyte and treated by laser surface melting (LSM) with various power densities. Compactness of the coatings was analyzed based on the scanning electron microscope images. The results showed that the porosity and the average diameter of pores were decreased, and a compact remelting layer was formed in the MAO + LSM coatings. On the discontinuous smelting surface of the MAO + LSM coatings, pores were often found in the individual melting micro area. Most of the molten pools originated in the pores of the MAO coating surface and as the laser energy absorbed continually, the discrete melted areas grew and finally expanded into continuous melted areas. The contents of anatase increased after LSM treatment, especially under low scanning speed of the laser beam.

The average hardness of MAO + LSM coatings is almost twice that of the hardness of an MAO coating, and the wear resistance is also excellent for compactness of LSM coating. Consequently, to improve the mechanical properties of TC4 treated by MAO, the secondary modification process of laser remelting plays a positive role.

The study 'Melting temperatures of Al_2O_3 and MgO under pressure'[7] by Z. Shuai and L. Hui of the Department of Materials Science and Engineering, Taiyuan University of Technology, Taiyuan, China, reports on the melting temperature–pressure phase diagram ($T_m(P)$–P) for corundum (Al_2O_3) and magnesium oxide (MgO). They are predicted through the Clapeyron equation in which the pressure-dependent volume difference is modeled by introducing the effect of surface stress-induced pressure. Corundum and magnesium oxide have been employed to test the reliability of the model.

The next paper[8] by P. Therasa Ranjani, P. Deepak Raj, B. Lakshmi Shree, S. Selva Priya and M. Sridharan of the Functional Nanomaterials & Devices Lab, Centre for Nanotechnology & Advanced Biomaterials and School of Electrical and Electronics Engineering, SASTRA University, Thanjavur, Tamil Nadu, India, reports their 'Studies on magnetron-sputtered V_2O_5/ZnO thin films'. Crystalline vanadium oxide (V_2O_5) thin films were grown on zinc oxide (ZnO) buffer layer-coated glass substrates at room temperature by magnetron sputtering technique. Initially, ZnO thin films have been formed by oxidizing sputtered zinc films at different annealing temperatures (300–500°C) in ambient air for 1 h. The influence of the ZnO buffer layer on the structural, morphological, optical and electrical properties of the V_2O_5 films was studied using X-ray diffraction (XRD), field-emission scanning electron microscopy, energy-dispersive analysis of X-rays, ultraviolet–visible spectrophotometry and four-point probe method. The thickness values of the deposited films were measured using the stylus probe profilometer. XRD patterns of the V_2O_5 films deposited over ZnO (VZO) showed reflection planes corresponding to V_2O_5 and the ZnO buffer layer. The optical studies showed enhancement in the optical properties of VZO buffer layer. The electrical studies of the VZO films showed that the resistivity of VZO films varied from 400 to 600 Ω cm. The enhancement in the optical and electrical properties may be due to the improvement in the crystallinity of the film because of the ZnO buffer layer.

S. Hemalatha, J. Tamil Illakkiya, Rachel Oommen and P. Usha Rajalakshmi of the Department of Physics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu, India, report their studies[9] on the 'Preparation and characterization of $ZnIn_2S_4$ thin film'. In this study, $ZnIn_2S_4$ (ZIS) crystalline thin film was prepared by novel spray pyrolysis technique. The as-deposited ZIS film was characterized by XRD technique, ultraviolet–visible–near infrared spectroscopy, field-emission scanning electron microscopy and energy-dispersive analysis by X-ray. XRD patterns revealed the crystalline nature of the material. Absorption edge was found to be at 471 nm. Direct band gap of the film was calculated and found to be 2·68 eV. The absorption coefficient of the ZIS film exhibits the maximum value of $5{\cdot}3 \times 10^6$ cm^{-1}. The as-deposited ZIS composition was nearly stoichiometric.

The assistance of Aditya Bhamidipati of Livingston High School, New Jersey and Natali Gendelberg of the Interdisciplinary Program in Materials Science & Engineering at the New Jersey Institute of Technology in the preparation of the figures in the manuscript is acknowledged with thanks.

REFERENCES

1. Murphy, S. V.; Atala, A. 3D bioprinting of tissues and organs, *Nat. Biotechnol*. **2014**, *32*, 773–785.
2. Ledford, H. The printed organs coming to a body near you. *Nature*. **2015**, *520*, 273.
3. Hardesty, L. Personalized heart models for surgical planning. MIT News, 17 September 2015. See http://news.mit.edu/2015/3-d-printed-heart-models-surgery-0917 (accessed 29/10/2015).
4. Apprecia Pharmaceuticals. FDA approves the first 3D printed drug product. See http://www.cureepilepsy.org/downloads/articles/3D-Printed-Drug-Product.pdf (accessed 29/10/2015).
5. Gowda, S.; Hotz, C.; Patnaik, A.; Manigandan, K.; Srivatsan, T. S. The microstructure, tensile response and fracture behavior of a high-performance structural steel: influence of orientation. *Emerg. Mater. Res*. **2015**, *4*, 255–264.
6. Wang, F.; Hou, B.; Yuan, K.; Wang, Y. Compactness of coatings treated by MAO and LSM on Ti alloy. *Emerg. Mater. Res*. **2015**, *4*, 265–272.
7. Shuai, Z.; Hui, L. Melting temperatures of Al_2O_3 and MgO under pressure. *Emerg. Mater. Res*. **2015**, *4*, 273–276.
8. Ranjani, P. T.; Raj, P. D.; Shree, B. L.; Priya, S. S.; Sridharan, M. Studies on magnetron-sputtered V_2O_5/ZnO thin films. *Emerg. Mater. Res*. **2015**, *4*, 277–285.
9. Hemalatha, S.; Illakkiya, J. T.; Oommen, R.; Rajalakshmi, P. U. Preparation and characterization of $ZnIn_2S_4$ thin film. *Emerg. Mater. Res*. **2015**, *4*, 286–289.