JOM, Vol. 69, No. 2, 2017
DOI: 10.1007/s11837-016-2227-0

Application of Advanced Characterization Techniques for Engineering Materials

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The Materials Characterization Committee under the TMS Extraction & Processing Division (EPD) Council organizes symposia for the TMS Annual Meeting and Exhibition. The aim of this technical committee is to cover a wide range of general topics that involves new and advanced characterization techniques used by materials researchers. This includes mechanical testing, x-ray diffraction and texture analyses, physical simulation, and advanced electron microscopy techniques.

The committee meets at TMS conferences to discuss symposium organization, committee focus, and *JOM* technical topics, among other topics.

Facing the vast diversified topics like extractive metallurgy, physical metallurgy, semiconductors, functional materials, coatings, polymers, ceramics and natural fibers, etc., the symposium organizers are often challenged to push forward focused sessions.

In this *JOM* issue, the committee selected ten top-ranked papers from past TMS annual meetings. The authors of those papers were invited to expand their manuscripts for this *JOM* publication.

Ping Lu's article evaluated the microstructures, mechanical properties and failure behavior of flash butt-welded HSLA 590CL steel joints. By using microscopy techniques, he was able to determine the existence of acicular ferrite, Widmanstatten ferrite, and granular bainite in the weld. He also performed micro-hardness, mechanical testing, and CVN impact test on welded joints, and compared them with base metal properties.

Shadia J. Ikhmayies studied cadmium sulfide for solar cell and optoelectronic devices applications. She fabricated CdS:In thin film by spray pyrolysis and characterized the coating using x-ray diffraction (XRD) and scanning electron microscopy (SEM) in an effort to correlate with its optical parameters. Dispersion of the refractive index was analyzed with the single oscillator model, and the influence of annealing on the dispersion parameters was also discussed.

Simona E. Hunyadi Murph et al. studied nanoparticle treated stainless steel filters for metal vapor sequestration. The authors developed a gold nanomaterial treated stainless steel filter (SSF) that can be efficiently used for zinc vapor sequestration. Without nanoparticle modification, stainless steel coupons do not react or alloy with Zn. The effect of surface topography on nanoparticle morphology, size and loading density were also investigated. Surface defects were found to have an impact on the AuNP growth and subsequently Zn sequestration.

Bowen Li et al. characterized the anorthite pyroxene ceramics made from hot poured steelmaking slag. Anorthite ceramic has many advantages for manufacturing and applications, such as appropriate strength, low electrical conductivity, low sintering temperature, broad materials supply, and low cost. It has attracted research attention for synthesis with various minerals. Li prepared anorthite ceramics by using hot-poured steelmaking slag at various temperatures. He concluded the major mineral components of ceramic have become anorthite and pyroxene at 1200°C. Wollostonite was involved in sintering reaction when the temperature was increased to 1200°C.

Zhiwei Peng led a comprehensive study on the power absorption characteristics of iron oxides and bitumite exposed to microwave radiation by evaluating their dielectric loss (QE) and/or magnetic loss (QH) distributions. He observed uneven dielectric and magnetic loss distributions in the slabs, and this phenomenon becomes more obvious at higher temperature at which the permittivity increases significantly. Identifying the power absorption

Jiann-Yang Hwang and Jian Li are the *JOM* advisors for the Materials Characterization Committee of the TMS Extraction & Processing Division, and guest editors for the topic Application of Advanced Characterization Techniques for Engineering Materials in this issue.

(Published online January 12, 2017)

distribution of the iron oxides and coal is important to improve the use of microwave energy in ferrous metallurgy.

Xiangwei Wu et al. studied the effect of lanthanum oxide on the microstructure and mechanical properties of 62 Cu–38 Zn alloy (brass) by using mechanical testing, hardness measurements, and scanning electron microscopy techniques. They were able to conclude that by adding La_2O_3 particles, the microstructure changed from dendrite to equiaxed grains, and the amounts and distribution of the β phase are substantially different. When the La_2O_3 content reaches 0.8 wt.%, the brass obtains optimum comprehensive mechanical properties. The strength and hardness decrease but ductility increases, which is conducive to plastic processing. Additionally, the corrosion resistance of the brass improved.

Shadia Jamil Ikhmayies reported her study on the optical parameters of spray-deposited $CdS_{1-y}Te_y$ thin films. She deposited indium doped $CdS_{1-y}Te_y$ thin films by first producing CdS:In thin films using the spray pyrolysis (SP) technique on glass substrates and then annealed the films in nitrogen atmosphere in the presence of elemental tellurium. The films appeared to be polycrystalline. The transmittance of the films was used to obtain their optical parameters such as the absorption coefficient, extinction coefficient, refractive index, real and imaginary parts of the dielectric constant, dispersion parameters, energy loss, and optical conductivity.

A.D. Brown et al. used three-dimensional x-ray tomography (XRT)—a nondestructive technique—to characterize the size, shape, and location of damage in dynamically loaded metals. He reported incipient transgranular hexagonal close-packed (HCP) spall damage nucleates in a lenticular shape and is heavily oriented along particular crystallographic slip directions. In polycrystalline materials, shape distributions indicate that a decrease in the tensile loading rate leads to a transition to coalesced damage dominance and that the plastic processes driving void growth are time dependent.

W. Li et al. studied corrosion resistance of austenitic stainless steels (SS) 310, 304, and Ni and Fe based A286 exposed to various pressures of 0.1 MPa, 8 MPa, and 29 MPa at 625°C for 1000 h. Extensive microscopy investigations revealed a single-layer oxide formed at 0.1 MPa and dual-layer oxides at 8 MPa and 29 MPa, followed by a Cr depleted region into the austenite substrate. The compositions of the inner oxides at 8 MPa and 29 MPa are Cr rich and largely similar to those of the single-layer oxides at 0.1 MPa exposures.

Peng Jin et al. characterized the magnetite scale formed in naphthenic acid corrosion. By using SEM and high-resolution TEM, the authors revealed the morphology and chemical composition of scales. Iron oxide (Fe_3O_4 or magnetite) scale and discrete particulates were found to exist on metal surfaces beneath the FeS scales on a low chrome steel. They suggested that the formation of the magnetite scale is a result of the decomposition of iron naphthenates at high temperatures. It is further postulated that a nano-particulate form of magnetite could improve corrosion resistance.

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