Editorial

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Conferences, like journals, provide opportunities for collaboration, networking and sharing ideas, and in many ways they bring the world together for the common good of science, technology and society. It has been twenty years since I began to organize symposia at the The Minerals, Metals and Materials Society (TMS) annual meetings.^{1,2} The 2016 TMS Annual Meeting and Exhibition was held in Nashville, Tennessee,³ with several focused symposia on Additive Manufacturing as one of its major highlights.

The International Union of Pure and Applied Chemistry (IUPAC) confirmed the addition of four new elements to the periodic table.⁴ The discovery of these new elements (113, 115, 117 and 118) has been made possible by the international collaborations between the Joint Institute for Nuclear Research in Dubna, Russia, the Lawrence Livermore National Laboratory, California, USA, and Oak Ridge National Laboratory, Tennessee, USA, and has been reported by Karol *et al.*^{5,6}

The Paris Agreement,⁷ as outlined in the 21st session of the United Nations, calls for ‘accelerating the reduction in global greenhouse gas emissions’ in order to address climate change. This will require stringent and stricter controls over emissions, including those from the manufacturing sector, and monitoring and control of the resulting byproducts and their safe disposal.

It has been twenty years since my long-term collaborator, Walter F. Kosonocky, passed away.⁸ Since Walter’s invention of the infrared charge-coupled-device (IR-CCD) imager thirty years ago,⁹ infrared imaging technology and its applications have grown exponentially. In addition to biological, defense, security, space and transportation applications, two of the key areas of use of infrared imaging in materials are in failure analysis and infrared thermometry.

Porous silicon was discovered in 1956.¹⁰ Since then, the quest for silicon photonics remains unabated. Mayer *et al.* have demonstrated the monolithic integration of nanowire lasers on silicon with very high spontaneous emission.¹¹ In recent years, silicon has also been shown to be an attractive material for anodes in energy storage devices.¹² From a non-silicon perspective, Yale *et al.* report an all-optical method in an individual nitrogen-vacancy center in diamond to accumulate a geometric phase;¹³ approaches such as this should help to develop devices for storing and processing quantum information.

This year marks the 90th anniversary since the award of the Nobel Prize in Physics to Jean-Baptiste Perrin for the verification

of Albert Einstein’s explanation of Brownian motion of minute particles suspended in liquids and the confirmation of the atomic nature of matter.¹⁴ While Brownian motion represents the random movement of microscopic particles in a fluid, it has been demonstrated that Brownian motion of magnetic nanoparticles can be a source of energy.¹⁵

The first of the papers in this issue by N. B. Singh and S. Agarwal of the Research and Technology Development Centre, Sharda University, Greater Noida, India presents ‘Nanocomposites: an overview’.¹⁶ Materials play a key role in every field of technology such as those concerning automobiles, aerospace, construction, electronics, medicine, sensors, computing, and so on, to make our lives more comfortable. There is always a critical need to use new materials with improved properties so that the demand for improvement can be satisfied. With the advancement of nanoscience, nanocomposites have emerged as very useful materials for a variety of applications. Various nanocomposites have been designed with the aim to achieve the desired thermal, electrical and mechanical properties. This paper presents an overview of the type, synthesis, characterization, properties, modeling and applications of nanocomposites in various sectors.

The second paper in this issue focuses on ‘Tensile biomechanical characteristics of the human meniscus’.¹⁷ This paper is a collaborative effort between S.-H. Yan, H. Wang and K. Zhang of the School of Biomedical Engineering and Beijing Key Laboratory of Fundamental Research on Biomechanics in Clinical Application, Capital Medical University, Fengtai District, Beijing, China, H.-K. Ou-Yang and Y.-L. Shan of the School of Biomedical Engineering, Capital Medical University, Beijing, China, and D.-Z. Luo of the Department of Orthopedics, Chinese People’s Liberation Army General Hospital, Beijing, China. The meniscus is an indispensable structure for the normal functioning of knee joints. Meniscal tears may cause intense clinical symptoms and predispose the knee to premature joint degeneration. Knowledge of its mechanical characteristics may serve as an experimental basis for future studies on the artificial synthesis of the meniscus, the clinical treatment of meniscus injury and finite-element modeling of the knee joint. However, few studies have concentrated on the biomechanical properties of the human meniscus. The authors performed uniaxial tensile experiments on samples from 20 human menisci using Bose 3330 Mechanical Experimental Machine. As the standard sample, they selected the longitudinal structure of a meniscus whose length-to-width ratio was 4:1. The human meniscus is different from general viscoelastic materials. There

were different biomechanical parameters inside and outside the ring of the meniscus. The magnitudes of ultimate load, elongation ratio, tensile stress, strain and elastic modulus of the inner ring were less than those in the outer ring. These findings provide the reference values for the parameters expressing the biomechanical characteristics of the meniscus in the Chinese population and it might be between bone and viscoelastic soft tissues. The medial loop of the meniscus was more prone to injury.

‘Modeling the triphasic mechanics of porous material in articular cartilage’ by L.C. Huang and Y. Cheng of the School of Engineering, Sun Yat-Sen University, Guangzhou, China, and X. Pan and T.T. Peng of the School of Pharmaceutical Sciences, Sun Yat-Sen University, Guangzhou, China, is the third paper in this issue.¹⁸ The unique mechanical properties of porous media in articular cartilage have been attributed to the complex structure and composition of the extracellular matrix, which consists of water and air/fluid phase and a solid matrix that is composed of a fibrous network of collagen and aggregating cells. This paper employs a recent constitutive model to summarize the important characteristics of the mechanics of porous media in articular cartilage. The progression of deformation in large-scale boundary value problems under monotonic loading conditions have been mapped based on the summarized mechanical characteristics. Simulations are presented to demonstrate how the proposed criterion can be applied to real-world situations. The methodology proposed herein provides a powerful means of assessing articular cartilage mechanics based on solid mechanical theory rather than empiricism.

The next paper ‘Nanostructured ZnO thin films by spin coating technique’¹⁹ is by J. Tamil Illakkiya, S. Hemalatha, P. Usha Rajalakshmi and R. Oommen of the Department of Physics, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, Tamil Nadu, India. In this study, nanocrystalline ZnO thin films were deposited on glass substrates using the sol-gel spin coating method. Two different sols were prepared using zinc acetate dihydrate as a precursor material dissolved in isopropyl alcohol as a solvent in the presence of two different aminoalcohols, including monoethanolamine (MEA) and triethanolamine (TEA), which act as stabilizers. The molar ratio of MEA/TEA to zinc acetate was maintained at 1:0. The influence of MEA/TEA on the structural, optical, morphological and electrical properties of ZnO thin films has been investigated by X-ray diffraction analysis, UV-Vis-spectrophotometry, photoluminescence, scanning electron microscopy with elemental composition analysis and four-probe techniques, respectively. X-ray analysis showed that the crystallinity and the particle size decreases for ZnO films with TEA as the stabilizing agent. Optical studies revealed that ZnO films with TEA were highly transparent and exhibited a large bandgap. Compared to TEA, MEA has a significant impact on the ZnO film morphology. The activation energy, E_a , was calculated and was found to be 0.4 eV and 0.2 eV for ZnO thin film with MEA and TEA stabilizers, respectively.

The next paper is on the ‘Study of stress annealing effect on giant magneto-impedance of Fe-based ribbons’²⁰ by G. Jianya, Y. Xiaohong and W. Shenggang of Jinhua Polytechnic, Jinhua, Zhejiang, China, Z. Jing, C. Ming and H. Xingwei of the College of Physics & Mathematics and Information, Zhejiang Normal University, Jinhua, China, and F. Yunzhang and S. Fangye of the Research Center for Light Emitting Diodes, Zhejiang Normal University, Jinhua, China. In this study, Fe-based nanocrystalline ribbons were successfully prepared. The giant magneto-impedance (GMI) effect that was found in these studies could be effectively increased by temperature annealing together with stress annealing. After applying a certain stress, the same GMI effect can be obtained with a much lower annealing temperature. In the present paper, it was found that the crystallization of an Fe-based sample can reach its best GMI effect with a ratio of ΔZ to Z at 1141% at 500°C annealing and 53 MPa.

The paper ‘Dynamic solutions on mode III interface cracks in Bi-copper’²¹ is by N. Lü and Q. Xiang of the School of Material Engineering, Shenyang Ligong University, Shenyang, China, G. Hao of the Department of Chemistry, Mudanjiang Normal College, Mudanjiang, China, and Y. Wang of the College of Mechanical Engineering, Liaoning Technical University, Fuxin, China. By utilizing the theory of complex variable functions, dynamic extension query solutions of symmetrical mode III interface cracks in bismuth-copper alloys were researched in this paper. The crack extension should also appear in the form of self-similarity because interface failure is ascertained by the maximum tensile stress. The formulation involves the development of a Riemann–Hilbert problem. The issues that were considered can be very easily transformed into Riemann–Hilbert problem according to the methods of self-similar functions, and the general representations of analytical solutions of the stresses, displacements and dynamic stress intensity factors for the edges of symmetrical mode III interface crack subjected to moving enhance loadings Px_6/t_6 and Pt_7/x_6 . In the light of correlative material properties, the changeable law of dynamic stress intensity factor was illustrated very well. The solutions were obtained by application of superposition principle in this paper, and the solutions of discretionally intricate queries could be readily acquired.

X.-P. Luo, X. Wang and Q.-S. Li of the Taiyuan University of Science and Technology, Taiyuan, Shanxi, China, report their studies on the ‘Microstructure and mechanical properties of shear-extruded Mg-Sn-Y-Zr alloys’.²² In this study, the microstructure and mechanical properties of as-cast and shear-extruded Mg-5.0Sn-1.5Y-0.1Zr alloys were investigated in detail using optical microscopy, scanning electron microscopy, X-ray diffraction and tensile tests. Results showed α -Mg dendrite, discontinuous acicular Mg₂Sn, and rod MgSnY phases along the grain boundaries in the as-cast alloy with average grain size of 90 μm . The fine rod and acicular Mg₂Sn and MgSnY phases, as well as their aggregations, were dispersed in the shear-extruded alloy. The grain size was refined to below 6.0 μm at a shear-extrusion temperature of 473 K and the tensile strength was increased from 131 MPa to 256 MPa.

M. Li, A. Wang, J. Xie, P. Zhang and Y. Sun of the College of Materials Science and Engineering, Henan University of Science and Technology, Luoyang, China, report their studies on the 'Influence of pretreatment of SiC particles on microstructure and properties of SiCp/A390 composites'.²³ In this study, two kinds of pretreatment methods of SiC particles were adopted: washing by HCl and high-temperature oxidation after washing by HCl. The powder metallurgy method was used for better controllability of the prepared particles of SiC-reinforced aluminum alloy composites of A390. The changes in the morphology and composition of the SiC particles after different pretreatment methods were studied; at the same time, the effects of different pretreatment methods on the microstructure and mechanical properties of SiC particle composites were analyzed. Research shows the following: washing by HCl of SiC particles is mainly cleaning, and high-temperature oxidation after washing by HCl of SiC particles is mainly a passivation effect, producing SiO₂ after high-temperature oxidation. High-temperature oxidation of SiC particles in the composites after HCl washing lead to the following: the particles distributed well; the interface bonding density improved; the resulting composites were without holes; the tensile strength and relative density of A390 aluminum alloy composites, reinforced by SiC particles, increased by 36% and 2.64% after oxidation treatment compared to the original state of SiC-reinforced aluminum alloy composites of A390, respectively.

The next paper 'Effects of CeO₂ on microstructure, friction and wear properties of SiCp/Al-Si composites'²⁴ is presented by H. Han, A. Wang, J. Xie and R. Wang of the School of Materials Science and Engineering, Henan University of Science and Technology, Luoyang, China. SiCp/Al-Si composites with the addition of CeO₂ were fabricated by powder metallurgy. The effect of CeO₂ content on microstructures, friction and wear properties of the SiCp/Al-Si composites were investigated. The modification mechanism of CeO₂ was also discussed in this paper. The results show that CeO₂ can refine the precipitated silicon particles. When the content of CeO₂ was 0.6%, the modification effect was the greatest. When the content of CeO₂ was more than 0.6%, the reunion phenomenon of CeO₂ gradually increased with the increase in the CeO₂ content. When the content of CeO₂ was 0.6%, the friction factor and friction force was the largest, the abrasion loss was the smallest. The wear mechanism of composites with varying contents of CeO₂ was abrasive wear and the wear surface of composite with 0.6% CeO₂ was the smoothest.

'Structural evaluation on TeO₂-SeO₂-R₂O ternary glass system using Raman and IR spectroscopy' is a study²⁵ by P. S. G. Rao, R. Siripuram and S. Suresh of the Department of Physics, JNTUHCEJ, Nachupally, Karimnagar, Telangana, India. Structural evaluation on 70TeO₂-20SeO₂-10R₂O (R = potassium (K), sodium (Na) and lithium (Li)) ternary glass system has been studied using infrared and Raman techniques. Main building units of both glass formers (tellurium dioxide (TeO₂) and selenium dioxide (SeO₂)) play a vital role in the construction of the

amorphous network. According to infrared and Raman data, it is clear that the structural building units appearing in the glass system are selenium trioxide (SeO₃), lithium tetraoxide (LiO₄), potassium tetraoxide (KO₄), sodium oxide (NaO), tellurium trioxide (TeO₃) and tellurium tetraoxide (TeO₄). Adding an alkali oxide to tellurium dioxide leads to a gradual reduction of the tellurium coordination from TeO₄ → TeO₃₊₁ → TeO₃; in addition to this, selenium dioxide also plays a vital role in forming the glass structure. Mixing potassium, sodium and lithium in the selenium-tellurite glass system results in cleavage of Te-O-Te and Se-O-Se linkages by the formation of TeO₃- and SeO₃-terminal groups. Among these, tellurium trioxide units are the dominant basic structural entities. Glass structural fragments are associated with the type of alkali oxide (potassium, sodium and lithium) and sterical hindrance of heavy alkali oxide produces distortions of the glassy network and reduces its rigidity.

The last paper in this issue is on the 'Effect of Co₃O₄ on the kinetics of thermal decomposition of diesel particulate matter'.²⁶ This study is reported by D. Mei, S. Yue, H. Wu and X. Zhao of the School of Automobile and Traffic Engineering, Jiangsu University, Zhenjiang, China, and Y. Yuan of the School of Mechanical Engineering, Nantong University, Nantong, China. Catalytic combustion of diesel particulate matter was performed over a Co₃O₄ catalyst in a thermogravimetric analysis system at distinct heating rates and catalyst content. Kinetic parameters were then estimated for several experimental conditions based on the Flynn-Wall-Ozawa method. These catalysts show good activity for diesel particulate oxidation, which is observed to be a factor of Co₃O₄ content. The results show that the addition of the catalyst has little effect on volatilization and oxidation of the soluble organic fraction but boosts the soot oxidation process. Considering the thermal gravimetric characteristics of non-catalyzed particulates as a baseline, with the increased trend of catalyst (Co₃O₄) content of 10 wt.% and 15 wt.%, the ignition temperature, the temperature corresponding to weight loss peak and burnout temperature of soot oxidation would descend at the same time. The activation energy observed for non-catalyzed and 15 wt.% Co₃O₄-catalyzed reactions are 212.6 kJ mol⁻¹ and 172.3 kJ mol⁻¹, respectively, which also confirms the catalytic activity of the catalyst for diesel particulate oxidation.

REFERENCES

1. The Minerals, Metals and Materials Society (TMS) (1997) *About the 1996 TMS Annual Meeting: Monday Afternoon Sessions (February 5). Transient Thermal Processing of Materials: Session I-V: Silicon Related Processes*. See <http://www.tms.org/Meetings/Annual-96/MonPM31.html> (accessed 23/02/2016).
2. Ravindra NM and Singh RK (eds) (1997) *Transient Thermal Processing Techniques in Electronic Materials*. TMS, Warrendale, PA, USA, 179 pp.
3. TMS (2016) *TMS2016 145th Annual Meeting & Exhibition*. See http://www.tms.org/meetings/annual-16/AM16home.aspx#.Vsm-v_krL0M (accessed 23/02/2016).

4. International Union of Pure and Applied Chemistry (IUPAC) (2015) *Discovery and Assignment of Elements with Atomic Numbers 113, 115, 117 and 118*. See <http://www.iupac.org/news/news-detail/article/discovery-and-assignment-of-elements-with-atomic-numbers-113-115-117-and-118.html> (accessed 23/02/2016).
5. Karol PJ, Barber RC, Sherrill BM, Vardaci E and Yamazaki T (2016) Discovery of the elements with atomic numbers $Z = 113, 115$ and 117 (IUPAC Technical Report). *Pure Applied Chemistry* **88**(1–2): 139–153.
6. Karol PJ, Barber RC, Sherrill BM, Vardaci E and Yamazaki T (2016) Discovery of the elements with atomic number $Z = 118$ completing the 7th row of the periodic table (IUPAC Technical Report). *Pure Applied Chemistry* **88**(1–2): 155–160.
7. Framework Convention on Climate Change (FCCC) (2015) Adoption of the Paris Agreement FCCC/CP/2015/L.9. *United Nations, Conference of the Parties, Twenty-first Session, Paris, France, 30 November to 11 December 2015*.
8. Tong FM, Ravindra NM and Kosonocky WF (1997) Design and simulation of permissible tolerance during fabrication of infrared-induced transmission filters. *Optical Engineering* **36**(2): 549–557.
9. Justia Patents (2016f) *Patents by Inventor Walter F. Kosonocky*. See <http://patents.justia.com/inventor/walter-f-kosonocky> (accessed 23/02/2016).
10. Uhler Jr A and Uhler I(W) (2005) Historical perspective on the discovery of porous silicon. *Physica Status Solidi (c)* **2**(9): 3185–3187.
11. Mayer B, Janker L, Loitsch B et al. (2016) Monolithically integrated high- β nanowire lasers on silicon. *Nano Letters* **16**(1): 152–156.
12. Liu N, Lu Z, Zhao J et al. (2014) A pomegranate-inspired nanoscale design for large-volume-charge lithium battery anodes. *Nature Nanotechnology* **9**: 187–192.
13. Yale CG, Heremans FJ, Zhou BB et al. (2016) Optical manipulation of the berry phase in a solid-state spin qubit. *Nature Photonics*, <http://dx.doi.org/10.1038/nphoton.2015.278>.
14. Encyclopaedia Britannica (2016) *Jean Perrin*. See <http://www.britannica.com/biography/Jean-Perrin> (accessed 22/02/2016).
15. Poláček J and Alexa P (2013) Brownian motion of magnetic nanoparticles as a source of energy? *International Journal of Nanotechnology* **10**(12): 1109–1114.
16. Singh NB and Agarwal S (2016) Nanocomposites: an overview. *Emerging Materials Research*, <http://dx.doi.org/10.1680/jemmr.15.00025>.
17. Yan SH, Ou-Yang HK, Shan Y-L et al. (2016) Tensile biomechanical characteristics of the human meniscus. *Emerging Materials Research*, <http://dx.doi.org/10.1680/jemmr.15.00031>.
18. Huang LC, Pan X, Peng TT and Cheng Y (2016) Modeling the triphasic mechanics of porous material in articular cartilage. *Emerging Materials Research*, <http://dx.doi.org/10.1680/jemmr.15.00005>.
19. Tamil Illakkiya J, Hemalatha, S, Usha Rajalaskhmi P and Oommen R (2016) Nanostructured ZnO thin films by spin coating technique. *Emerging Materials Research*, <http://dx.doi.org/10.1680/jemmr.15.00022>.
20. Jianya G, Xiaohong Y, Shenggang W et al. (2016) Study of stress annealing effect on giant magneto-impedance of Fe-based ribbons. *Emerging Materials Research*, <http://dx.doi.org/10.1680/jemmr.16.00004>.
21. Lü N, Xiang Q, Hao G and Wang Y (2016) Dynamic solutions on mode III interface cracks in Bi-copper. *Emerging Materials Research*, <http://dx.doi.org/10.1680/jemmr.15.00019>.
22. Luo X-P, Wang X and Li Q-S (2016) Microstructure and mechanical properties of shear-extruded Mg-Sn-Y-Zr alloys. *Emerging Materials Research*, <http://dx.doi.org/10.1680/jemmr.15.00032>.
23. Li M, Wang A, Xie J, Zhang P and Sun Y (2016) Influence of pretreatment of SiC particles on microstructure and properties of SiCp/A390 composites. *Emerging Materials Research*, <http://dx.doi.org/10.1680/jemmr.15.00059>.
24. Han H, Wang A, Xie J and Wang R (2016) Effects of CeO₂ on microstructure, friction and wear properties of SiCp/Al-Si composites. *Emerging Materials Research*, <http://dx.doi.org/10.1680/jemmr.15.00013>.
25. Rao PSG, Sripuram R and Suresh S (2016) Structural evaluation on TeO₂-SeO₂-R₂O ternary glass system using Raman and IR spectroscopy. *Emerging Materials Research*, <http://dx.doi.org/10.1680/jemmr.15.00011>.
26. Mei D, Yue S, Wu H, Zhao X and Yuan Y (2016) Effect of Co₃O₄ on the kinetics of thermal decomposition of diesel particulate matter. *Emerging Materials Research*, <http://dx.doi.org/10.1680/jemmr.15.00009>.