

The Third Pan American Materials Congress: Integrating Materials Across the Americas

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BACKGROUND AND OVERVIEW

The Third Pan American Materials Congress marked the success of an initiative that started in 2007. It originated from a partnership between the Brazilian Metallurgical, Materials, and Mining Society (ABM) and The Minerals, Metals and Materials Society (TMS). The seed was planted by Diran Apelian in his tenure as TMS President, whose vision of a North–South integration in the Americas led to a Memorandum of Understanding between TMS and ABM. Prior to that, preliminary discussions held between Robert Shull, Brajendra Mishra, Horacídio Leal, Sergio Neves Monteiro, and Marc Meyers led to the suggestion of a greater integration among materials societies in the Americas, through a new conference series.

The First TMS-ABM International Materials Congress, held in 2010 in Rio de Janeiro, marked the beginning of a partnership that also included representatives from corresponding societies of Argentina, Canada, Chile, Colombia, Mexico and Peru. As a natural evolution, the Second Pan American Materials Congress was held in 2014 in São Paulo, in conjunction with ABM's large annual conference. The Third Pan American Materials Congress, held in San Diego, included nine participating professional societies. It was co-located with the TMS 2017 Annual Meeting and Exhibition, with TMS in the role of host society. A program covering a variety of materials science topics was created based upon input from leading scientists and engineers representing eight countries and the nine international materials, metals, and minerals societies:

- Argentina—Asociación Argentina de Materiales (SAM)

- Brazil—Associação Brasileira de Metalurgia, Materiais e Mineração (ABM)
- Canada—Metallurgy and Materials Society (MetSoc), Canadian Institute of Mining, Metallurgy, and Petroleum (CIM)
- Chile—Instituto de Ingenieros de Minas de Chile (IIMCh)
- Chile—Sociedad Chilena de Metalurgia y Materiales (SOCHIM)
- Colombia—Colombian Materials Society
- Mexico—Sociedad Mexicana de Materiales (SMM)
- Peru—Asociación Peruana de Metalurgia, Materiales Y Minerales (APMMM)
- United States—TMS (host society)

The fourth conference will be held in Monterrey, Mexico, in 2019, hosted by the Mexican Materials Society and chaired by Armando Salinas.

TECHNICAL TOPICS AND CONTENT

The 3rd PAMC technical programming encompassed a wide range of materials, metals, and minerals with applications specific to the international communities that are represented. Featured symposia scopes included topics such as lightweight materials for structural applications, corrosion and corrosion protection of both metallic and non-metallic materials, biomaterials, and extraction and processing of rare earth minerals and elements. These subjects, along with the other topics found across all ten symposia, made for a comprehensive conference reflecting materials-related innovations from North and South American countries. A full list of the individual symposia is shown below:

- Materials for Transportation
- Materials for Lightweighting
- Steels
- Advanced Manufacturing
- Materials for Green Energy
- Materials for Infrastructure

Marc A. Meyers and Sergio Neves Monteiro are the guest editors of this special topic which highlights presentations from The Third Pan American Materials Congress held in conjunction with the TMS 2017 Annual Meeting and Exhibition, San Diego, CA, February 26–March 2, 2017.



Fig. 1. Founding members of the Brazilian Society for Metals; Robert Mehl is fourth from the left.

- Materials for the Oil and Gas Industry
- Advanced Biomaterials
- Minerals Extraction and Processing
- Nanocrystalline and Ultra-fine Grain Materials & Bulk Metallic Glasses.

Technical Contributions in This Issue

Eight distinguished plenary speakers contributed to the conference; the papers in this technical topic represents some of these with additional papers by leaders in the field. Terence Langdon and co-workers incorporated into the program a superb symposium on ultra-fine-grained materials. Representing the U.S., Enrique Lavernia presented an overview of a topic of great contemporary importance: high entropy alloys. From Brazil, Fernando Rizzo presented on the importance of materials in global warming and the energy requirements of humankind. Argentina was represented by Carlos Schvezov, who focused in his talk on biomaterials. Other plenary contributions at the event included Carolyn Hanson (Canada), Diran Apelian (US), Alejandro Toro (Colombia), and Salvador Valtierra (Mexico). The four plenary lectures presented in this special topic are supplemented by two additional contributions that represent outstanding Pan American integration efforts. Sergio Neves Monteiro and students contribute with their biomaterials work.

In addition to the articles in this issue, a special proceedings volume, edited by the symposium organizers and containing 80 contributions,¹ was published by Springer in collaboration with TMS.

PIONEER OF INTEGRATION: ROBERT FRANKLIN MEHL

Robert Franklin Mehl (1898–1976) played a vital role in the transforming of nineteenth-century metallurgy into modern materials science, and initiated the process of integrating metallurgical activities across the Americas by building a bridge between Brazil and the US. In 1944, he came to São Paulo and was instrumental in the founding of the Brazilian Society for Metals (Fig. 1), inspired by the American Society for Metals. ABM has played a pivotal role in the development of the metal industry in Brazil and has stimulated materials research.

During World War II, Mehl was asked to go to Brazil to strengthen the bonds with this large country which was important in the war effort. Brazil was a source of raw materials and joined the Allied effort in 1944, sending troops to fight in Italy. A large steel mill was built under a US–Brazil agreement that included the construction of a railroad connecting the capital to the north. Therefore, Mehl's visit had strategic implications.

Mehl helped to develop, during his one-year stay at the University of São Paulo, the framework for metallurgical education in Brazil. His lectures were published in book form by ABM,² and he established lasting contacts that led to his advising of two brilliant students, the first Brazilians to obtain their doctorates in metallurgy in the US: Luis Correia da Silva and Walter Arno Mannheimer. Both were to play important roles in the development of the scientific metallurgical foundations in Brazil: Luis

Correia da Silva in the Institute of Technological Research and University of São Paulo, and later in UNIDO, and Walter Mannheimer as the founding head of the first post-graduate materials program in Brazil (COPPE), at the Federal University of Rio de Janeiro. Around 1949, and as a result of Mehl's visits to Brazil, Luis Correia da Silva joined his laboratory as a graduate student. He became one of the main protagonists in one of the controversies that make the metallurgical history fascinating. Kirkendall and students had published, in 1939,³ 1942,⁴ and 1947,⁵ three articles on the movement of inert markers in a diffusion couple, providing evidence for a vacancy mechanism of diffusion. Mehl, not a believer of vacancies and dislocations, opposed the experimental results and principally the explanation given by Kirkendall on the differences in diffusion coefficients in diffusion couples. In order to verify that the Kirkendall Effect was wrong, Mehl instructed Luis C. da Silva to carry out systematic experiments for interdiffusion, not only in Cu/ α -brass, but also in Cu/Sn, Cu/Al, Cu/Ni, Cu/Au, and Ag/Au. To Mehl's dismay, da Silva confirmed the marker movement, which is undoubtedly associated with the way atoms move during diffusion (i.e., by the Kirkendall mechanism involving vacancies). The study, that proved to be a classic confirmation of the Kirkendall effect, was published by Correia da Silva and Mehl in 1951.⁶ In his NAS biography it is stated that, many years later, he apologized to Kirkendall, when the latter visited him after he was bedridden. In 1998, Correia da Silva wrote a discussion on this controversy.⁷

The Past Inspiring the Future

The process of research integration that took place between Brazil and the United States in the past three-quarters of a century is being expanded to the Americas and this conference series represents a significant vehicle. Beyond the training of young students, the exchange of ideas and economic development will be accelerated by the formation of materials societies in all the countries and their integration in a network that accelerates communication. We hope to have contributed to this worthy cause.

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The following papers are published under the topic "3rd Pan American Materials Congress" in the October 2017 issue (vol. 69, no. 10) of *JOM* and can be accessed via the *JOM* page at <http://link.springer.com/journal/11837/69/10/page/1>.

- "Developments in Processing by Severe Plastic Deformation at the 3rd Pan American Materials Congress" by Roberto B. Figueiredo, Megumi Kawasaki, and Terence G. Langdon.
- "Recent Progress in High Entropy Alloy Research" by B.E. MacDonald, Z. Fu, B. Zheng, W. Chen, Y. Lin, F. Chen, L. Zhang, J. Ivanisenko, Y. Zhou, H. Hahn, and E.J. Lavernia.
- "Facing Global Challenges with Materials Innovation" by Fernando Rizzo.
- "Production and Characterization of Nano Films of TiO₂ for Hemocompatible and Photocatalytic Applications" by C.E. Schvezov, M.L. Vera, J.M. Schuster, and M.R. Rosenberger.
- "Porosity Assessment for Different Diameters of Coir Lignocellulosic Fibers" by Fernanda Santos da Luz, Sidnei Paciornik, Sergio Neves Monteiro, Luiz Carlos da Silva, Flávio James Tommasini, and Verônica Scarpini Candido.
- "Mallow Fiber-Reinforced Epoxy Composites in Multilayered Armor for Personal Ballistic Protection" by Lucio Fábio Cassiano Nascimento, Luis Henrique Leme Louro, Sergio Neves Monteiro, Édio Pereira Lima Junior, and Fernanda Santos da Luz.

REFERENCES

1. M.A. Meyers, H.A.C. Benavides, S.P. Brühl, H.A. Colorado, E. Dalgaard, C.N. Elias, R.B. Figueiredo, O. Garcia-Rincon, M. Kawasaki, T.G. Langdon, R.V. Mangalaraja, M.C.G. Marroquin, A. da Cunha Rocha, J. Schoenung, A. Costa e Silva, M. Wells, and W. Yang (eds.), *Proceedings of the Third Pan American Materials Congress*. Springer (2017).
2. R.F. Mehl, *Metalurgia do Ferro e do Aço*, ABM (1945).
3. E. Kirkendall, L. Thomasson, and C. Upthegrove, *Trans. AIME* 133, 186 (1939).
4. E.O. Kirkendall, *Trans. AIME* 147, 104 (1942).
5. A.D. Smigelskas and E.O. Kirkendall, *Trans. AIME* 171, 130 (1947).
6. L.C.C. da Silva and R.F. Mehl, *Trans. AIME* 191, 155 (1951).
7. L.C.C. da Silva, *J. Met.* 50, 6 (1998).