



Editorial: Sol-gel in Latin America

Sara A. Bilmes¹ · Galo J. A. A. Soler-Illia² · Sidney J. Ribeiro³

Published online: 7 April 2022

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2022

Latin America is a diverse territory in which millenary cultures and heterogeneous immigrations blend together with a common denominator, the Iberian language with its variants: Castilian, Portuguese and the increasingly adopted *Portuñol*, a mixture between these languages.

The scientific trajectory in Latin America is greatly influenced by the parameters of the central countries (past and present), but with a serious lack of the infrastructure or state support of the first world and, fundamentally, with few local recipients of the produced knowledge. Under these conditions, this continent of emerging countries has produced 17 Nobel laureates, including two in Chemistry and three in Medicine, who, with the exception of Bernardo Houssay and Luis F. Leloir, carried out their prize-winning research in the central countries.

Latin American science is deeply rooted in the cooperation with the central countries that has been fostered since the 19th century. This is an asymmetrical cooperation

that today translates into access to joint instrumental facilities and publications, as well as the persistence of the developed countries' scientific model [1].

The successive political ups and downs in our continent since the post-war and the Cold War periods have produced significant budget cuts and a diaspora of scientists, many of whom migrated across LA countries, favoring interaction between Latin American diversities. More recently, and thanks to the continuous efforts to intensify “south-south” cooperation since the 1960s, there have been closer collaborations between Latin American countries that address more specific environmental, health and energy problems in countries that export raw materials rather than products derived from natural resources. Indeed, Latin American scientists are making an impact in the world of materials science, as recently shown in several thematic journal issues [2, 3].

The footprint of sol-gel processes in Latin America dates back at least to the development of the pigment “maya blue” (ca. 500 AD), a nanostructured hybrid material resistant to sunlight, high temperatures, biodegradation, acids, alkalis, and organic solvents [4]. With interruptions and, with the scientific culture of the so-called first world established, sol-gel chemistry developed significantly, with numerous research groups linked to materials science. Some positive government initiatives as the establishment of networking programs in Brazil, Argentina or Mexico, institutions such as the Brazilian-Argentina Center of Nanotechnology (CBAN) or the synchrotron facilities in Campinas (LNLS-Sirius) have also been crucial in the development of the community. This presence is reflected in publications, schools and the organization of Sol-Gel Conferences in Brazil in 1989 and 2009 (<https://www.isgs.org/community/sol-gel-science-and-technology-in-latin-america>).

The strength in the research of sol-gel processes in Latin America is also manifested in the training of young people through doctoral student exchanges with bilateral cooperation programs, such those funded by the Brazilian agencies CAPES, CNPq and Fapesp, nine International Sol-Gel schools (Buenos Aires School of Materials

This Special issue is dedicated to those who fostered sol-gel in Latin America: Michel Aegerter, Miguel A. Blesa, Saúl Cabrera, Antonio Campero Celis, Aldo Craievich, Alicia Durán and Miguel J. Yacamán

- ✉ Sara A. Bilmes
sarabil@qi.fcen.uba.ar
- ✉ Galo J. A. A. Soler-Illia
gsoler-illia@unsam.edu.ar
- ✉ Sidney J. Ribeiro
sidney.jl.ribeiro@unesp.br

¹ Instituto de Química Física de los Materiales, Medio Ambiente y Energía, (INQUIMAE) CONICET and Departamento de Química Inorgánica, Analítica y Química Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Buenos Aires, Argentina

² Instituto de Nanosistemas, Escuela de Bio y Nanotecnología, Universidad Nacional de General San Martín-CONICET, Av 25 de Mayo 1021, 1650, San Martín, Buenos Aires, Argentina

³ Institute of Chemistry, São Paulo State University (UNESP), 14800-060 Araraquara-SP, Brazil

Synthesis and Sol-Gel Processes, biennial since 2003) (<http://arkham.exp.dc.uba.ar/solgel2019/index.php/generallidades>), and ten NanoAndes schools (annual, since 2011 in different countries) (<https://nanoandesred.com/nosotros>). These schools are unique, in that state-of-the-art techniques are transferred to the young researchers by renowned experts, but also in “hands-on” laboratory sessions, which is crucial to build the community and promoting the creed that creative and high quality materials science can be carried out in our continent. We were very pleased to witness scientific exchange and discussions in *Portuñol* during the scientific sessions and lab experiences along the years.

This special issue contains 23 papers produced in five Latin American countries that discuss in depth reaction mechanisms, stability and optical response of materials produced by sol-gel oriented toward diverse applications such as coatings, catalysis and photocatalysis or drug delivery. A small sample of the originality of thought, ingenuity and quality of science produced in LA, even with limited resources and infrastructure. It is worth highlighting that although there was no prior selection by gender, 45% of the papers were led by women (corresponding author) and only 10% of the articles were co-authored exclusively by men. This is an encouraging indication of the positive impact of the various actions undertaken in Latin America for gender equity in STEM. Many of these papers stem from young researchers in the area, who were once graduate

students in the Buenos Aires and Nanoandes schools, which is a living proof of the strength and high scientific quality of the new generation of sol-gel scientists with deep roots and a bright future.

Compliance with ethical standards

Conflict of interest The authors declare no competing interests.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

1. Feld A, Kreimer P (2020) Latinoamericanos en proyectos europeos. *Cienc Tecnolía Y política* 3:035. <https://doi.org/10.24215/26183188e035>
2. Merino G, Fernández-Herrera M, Soler-Illia GJAA, Zarkin A, Zuin Zeidler V, Chamorro E, Oliveira L, Mesko M, Fraga C, Alvarado I, Dupont J, Nogueira A, Graeff C, Pastore H, Júnior EAzzaroni O (2021) Introduction to celebrating Latin American talent in chemistry. *RSC Adv* 11:40216–40219. <https://doi.org/10.1039/D1RA90175C>
3. Gomez G, Soler-Illia GJAA(2021) Virtual Issue on Multifunctional Nanoporous Materials in Latin America. *Chem Mater* 33:7569–7571. <https://doi.org/10.1021/acs.chemmater.1c03013> 19
4. Faustini M, Nicole L, Ruiz-Hitzky E, Sanchez C(2018) History of Organic–Inorganic Hybrid Materials: Prehistory, Art, Science, and Advanced Applications. *Adv Funct Mater* 28:1704158. <https://doi.org/10.1002/adfm.201704158>