



# JBCS

## Editors

**Adriano L. Monteiro**  
Universidade Federal do Rio Grande do Sul  
Brazil

**Roberto M. Torresi**  
Universidade de São Paulo  
Brazil

**Jaísa Fernandes Soares**  
Universidade Federal do Paraná  
Brazil

**Solange Cadore**  
Universidade Estadual de Campinas  
Brazil

**Paulo Cezar Vieira**  
Universidade Federal de São Carlos  
Brazil

**Watson Loh (coordinator)**  
Universidade Estadual de Campinas  
Brazil

---

## Associate Editors

**Brenno A. D. Neto**  
Universidade de Brasília  
Brazil

**Emanuel Carrilho**  
Universidade de São Paulo  
Brazil

**José Walkimar M. Carneiro**  
Universidade Federal Fluminense  
Brazil

**Teodoro S. Kaufman**  
Universidad Nacional de Rosario  
Argentina

**Edenir Rodrigues Pereira Filho**  
Universidade Federal de São Carlos  
Brazil

**Emerson F. Queiroz**  
Université de Genève  
Switzerland

**Márcia O. F. Goulart**  
Universidade Federal de Alagoas  
Brazil

**Vanessa Hatje**  
Universidade Federal da Bahia  
Brazil

**Eduardo Carasek da Rocha**  
Universidade Federal de Santa Catarina  
Brazil

**Humberto Osório Stumpf**  
Universidade Federal de Minas Gerais  
Brazil

**Pedro H. C. Camargo**  
Universidade de São Paulo  
Brazil

---

## Editorial Advisory Board

**Antonio Canals**  
Universidad de Alicante  
Spain

**Eusébio Juaristi**  
Centro de Investigación y de Estudios Avanzados  
del Instituto Politécnico Nacional - Mexico

**Jailson B. de Andrade**  
Universidade Federal da Bahia  
Brazil

**Ludger Wessjohann**  
Leibniz Institute of Plant Biochemistry  
Germany

**Susan Lunte**  
University of Kansas  
USA

**António Joaquim de C. Varandas**  
Universidade de Coimbra  
Portugal

**Fernando Galembeck**  
Centro Nacional de Pesquisa em Energia e Materiais  
Universidade Estadual de Campinas  
Brazil

**James Landers**  
University of Virginia  
USA

**Ralph E. Sturgeon**  
National Research Council Canada  
Canada

**Yvonne P. Mascarenhas**  
Universidade de São Paulo  
Brazil

**Eva M. Krupp**  
University of Aberdeen  
UK

**Henrique E. Toma**  
Universidade de São Paulo  
Brazil

**Juan Cesar Scaiano**  
University of Ottawa  
Canada

**Richard G. Weiss**  
Georgetown University  
USA

**Zhong-Qun Tian**  
Xiamen University  
China

---

**Editorial Manager:** Angela Ramalho Custodio

**Editorial Manager Assistants:** Aya Hase and Maria Suzana Prata Vieira Francisco

**Standard Reviewers:** Cristina Battesini Adamo, Cristina Rodrigues Gabriel Sales, Elaine Cristina Cabral, Laís Calixto S. Sipahi, Telma Rie Doi Ducati

**Founding Editor:** Eduardo M. A. Peixoto

**Former Editors:** Angelo da Cunha Pinto<sup>†</sup>, Armi W. da Nóbrega, Fernando Galembeck, Francisco Radler de Aquino Neto, Gerardo G. B. de Souza, Henrique E. Toma, Jailson B. de Andrade, Jaswant R. Mahajan, Joaquim A. Nóbrega, Koiti Araki, Luis A. Avaca, Luiz Carlos Dias, Luiz Carlos G. Freitas, Marco-Aurélio De Paoli, Maria D. Vargas, Maysa Furlan, Miguel Jafelicci Jr., Mônica Tallarico Pupo, Oswaldo L. Alves, Pedro J. M. Abreu, Ricardo Longo and Ronaldo A. Pilli.

**Former members of the Advisory Board:** Giuseppe Cilento<sup>†</sup>, Jaswant R. Mahajan, Linus Pauling<sup>†</sup>, Hitoshi Ohtaki, Isabella Karle, Klaus Hafner, Kozo Kuchitsu, Russell A. Bonham, Vicente G. Toscano, Jerome Karle, Henry Taube<sup>†</sup>, Alejandro J Arvia, Clayton H. Heathcock, G. Jeffery Leigh, José Manuel Riveros, Otto Richard Gottlieb<sup>†</sup>, Alberto Nuñez Sellés, C. N. R. Rao, Jean-Marie Lehn, José Luiz F. Costa Lima, Miguel de la Guardia and Roberto Sanchez-Delgado.

The *Journal of the Brazilian Chemical Society* is published once a month by PubliSBQ of the *Sociedade Brasileira de Química*.

**SBQ Periodicals Coordinator: Adriano D. Andricopulo**

**Editorial and Publishing Office:**

Instituto de Química, Universidade Estadual de Campinas, CP 6154, 13083-970 Campinas - SP, Brazil  
Phone/Fax: +55 19 3521-3151; E-mail: office@jbcs.sbq.org.br

**Subscriptions and Advertising Office:**

Sociedade Brasileira de Química, CP 26037, 05513-970 São Paulo - SP, Brazil  
Phone: +55 11 3032-2299; Fax: +55 11 3814-3602; E-mail: assinaturas@sbq.org.br

The *Journal of the Brazilian Chemical Society* serves its readers as a forum for information related to the advancement of Chemistry. The *Journal* is devoted to the publication of research papers in all fields of Chemistry, except education, philosophy and history of Chemistry

**Information for authors:** Full details of how to submit material for publication in the *Journal of the Brazilian Chemical Society* (online submission by ScholarOne platform) are given in the link **Instructions for Authors** <http://jbcs.sbq.org.br/instr.authors>

**Galley proofs** are sent by the Editorial Office to the author who submitted the manuscript. Proofs should be checked and returned as soon as possible (preferably within 48 hours)

**Subscription Rates - 2016:** Members of the Brazilian Chemical Society: R\$1200,00. Non-members and Institutions: R\$1500,00 (Brazil). Institutions (Latin Amer.): US\$520.00 and US\$660.00 (other countries). See also World Wide Web <http://www.sbq.org.br>

**Back issues:** Back issues of all previously published volumes are available directly from the Subscriptions Office

**Creative Commons (CC) and iThenticate:** Through SciELO (<http://www.scielo.org/php/index.php>), JBCS has adopted CC-BY license from the 26-9 issue on as the main role of the Open Access. Such license, already being used internationally by leading journals and open-access publishers, aims at maximizing the dissemination of articles. Also, has started to use the anti-plagiarism tool iThenticate, benefited from an agreement supported by the Brazilian Association of Scientific Editors (ABEC), at the end of 2015.

Copyright © 2016 Sociedade Brasileira de Química

It is a condition for publication that manuscripts submitted to this journal have not yet been published and will not be simultaneously submitted or published elsewhere. By submitting a manuscript, the authors agree that the copyright for their article is transferred to the *Sociedade Brasileira de Química* (SBQ) if and when the article is accepted for publication. The copyright covers the exclusive rights to reproduce and distribute articles, including reprints, photographic reproductions, microform or any other reproductions of a similar nature, including translations. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, whether electronic, electrostatic or mechanical, nor by photocopying, recording, magnetic tape or otherwise, without written permission from the copyright holder.

While every effort is made by the SBQ, editors and editorial board to see that no inaccurate or misleading data, opinions or statements appear in this journal, they wish to make it clear that the contents of the articles and advertisements published herein are the sole responsibility of the contributors or advertisers concerned. Accordingly, the SBQ, the editorial board and editors and their respective employees, officers and agents accept no responsibility or liability whatsoever for the consequences of any such inaccurate or misleading data, opinion or statement.

**Photocopying information for users in the USA.** The Item-Fee Code for this publication indicates that authorization to photocopy items for internal or personal use is granted by the copyright holder for libraries and other users registered with the Copyright Clearance Center (CCC). Transactional Reporting Service provided the stated fee for copying beyond that permitted by Section 107 and 108 of the United States Copyright Law is paid. The appropriate remittance of \$ 6.00 per copy per article is paid directly to the Copyright Clearance Center Inc., 222 Rosewood Drive, Danvers, MA 01923, USA

**Permission for other use.** The copyright owner's consent does not extend to copying for general distribution, for promotion, for creating new works, or for resale. Specific written permission must be obtained from the Publisher for such copying

The Item-Fee Code for this publication is: 0103-5053 \$6.00 + 0.00

Printed on acid-free paper

**Indexed in the following databases:** Science Citation Index®, Science Citation Index expanded (SciSearch®), ISI Alerting Services, Chemical Abstracts-CA Plus, Chemistry Citation Index®, Current Contents®/Physical, Chemical and Earth Sciences, IndexCopernicus, Portal de Periódicos da Capes, SciELO and SCOPUS

Financial support:



Printed in Brazil

**Desktop Publishing: Hermans - Phone: +55 11 5571-8937**

**Printed by: Print Master - Phone: +55 19 3223-1044**