

# AICHE JOURNAL

VOL. 49, NO. 8 **AUGUST 2003**

The AICHE JOURNAL, a monthly publication of the American Institute of Chemical Engineers, is devoted to fundamental research and developments having immediate or potential value in chemical engineering.



[www.aiche.org](http://www.aiche.org)

**Editor**

Stanley I. Sandler

**Publisher and Executive Editor**

Haeja Lim Han

**Associate Editors**

Mark A. Barteau

Edward L. Cussler

Ignacio Grossmann

Julio M. Ottino

Sankaran Sundaresan

**Copy Editor**

Arthur H. Baulch

**Editorial Assistants**

Sally Mahon

Jed Hazlett

**Cover Design**

Fran Fresquez

**Consulting Editors**

Rakesh Agrawal

*Separation Processes*

Ilhan A. Aksay

*Materials Processing*

Timothy J. Anderson

*Electronic Materials*

Juan Jose de Pablo

*Computational Research*

Thomas F. Edgar

*Systems and Control*

L. S. Fan

*Particle Technology*

Carol K. Hall

*Thermodynamics*

Sangtae Kim

*Information Technology*

Frederick J. Krambeck

*Reactor Engineering*

Anton P. J. Middelberg

*Biomedical Engineering*

Ronald W. Rousseau

*Crystallization*

John H. Seinfeld

*Environmental Engineering*

Michael L. Shuler

*Biochemical Engineering*

Levi Thompson

*Catalysis and Reaction Engineering*

**Group Publisher**

Stephen R. Smith

*AIChE Journal* (ISSN 0001-1541)

is published monthly by the American Institute of Chemical Engineers, Three Park Avenue New York, NY 10016-5991.

Manuscripts should be submitted to the *AIChE Journal* Editorial Office Dept. of Chemical Engineering University of Delaware Newark, DE 19716-3110 Tel 302.831.6858 Fax 302.831.3226. E-mail: [aichej@che.udel.edu](mailto:aichej@che.udel.edu)

The statements and opinions in the *AIChE Journal* are those of the contributors, and AIChE assumes no responsibility for them.

Annual subscription rates are as follows.

Print version only:

N. American members, \$115

International members, \$215

N. American nonmembers, \$1,040

International nonmembers, \$1,140

Online version only:

Members, \$165

Nonmembers, \$1,100

Print plus Online:

N. American members, \$185

International members, \$285

N. American nonmembers, \$1,250

International nonmembers, \$1,350

For subscription, e-mail: [xpress@aiche.org](mailto:xpress@aiche.org) or phone: 1-800-242-4363 (Toll Free) or 1-212-591-8100

Postage for domestic and international mailing paid at New York City and additional mailing offices.

Copyright © 2003 by the American Institute of Chemical Engineers.

POSTMASTER: Send change of addresses to *AIChE Journal* Three Park Avenue New York, NY 10016-5991.

Authorization to photocopy for internal or personal use is granted by AIChE for libraries and other users registered with the Copyright Clearance Center (CCC), provided that a fee of \$25.00 per article is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923. For its digital access, contact CCC by visiting [rightslink.copyright.com/](http://rightslink.copyright.com/). This consent does not extend to copying for general distribution, inclusion in a publication, or resale, promotion and advertising.