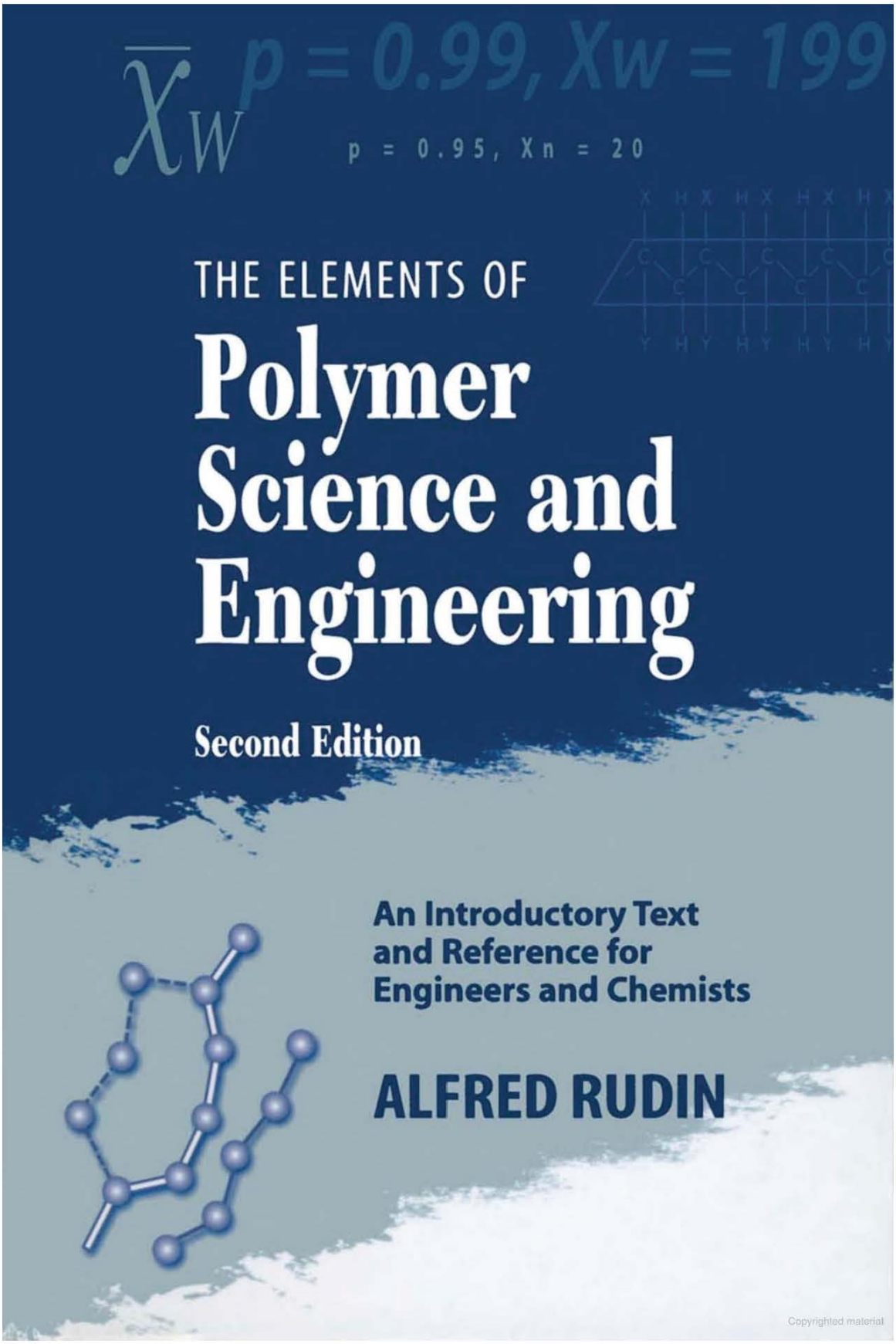


DOCKET ALARM
Find authenticated court documents without watermarks at docketalarm.com.

THE ELEMENTS OF

Polymer Science and Engineering

Second Edition

An Introductory Text and Reference
for Engineers and Chemists

Alfred Rudin
University of Waterloo

ACADEMIC PRESS
An Imprint of Elsevier
San Diego London Boston
New York Sydney Tokyo Toronto

Copyrighted material

DOCKET ALARM
Find authenticated court documents without watermarks at docketalarm.com.

This book is printed on acid-free paper. ♾

Copyright © 1999 by Academic Press

All Rights Reserved.
No part of this publication may be reproduced or
transmitted in any form or by any means, electronic
or mechanical, including photocopy, recording, or
any information storage and retrieval system, without
permission in writing from the publisher.

Permissions may be sought directly from Elsevier's Science and Technology Rights Department in Oxford, UK. Phone: (44) 1865 843830, Fax: (44) 1865 853333, e-mail: permissions@elsevier.co.uk. You may also complete your request on-line via the Elsevier homepage: http://www.elsevier.com by selecting "Customer Support" and then "Obtaining Permissions".

ACADEMIC PRESS
An Imprint of Elsevier
525 B Street, Suite 1900, San Diego, CA 92101-4495, USA
http://www.apnet.com

ACADEMIC PRESS
24–28 Oval Road, London NW1 7DX, UK
http://www.hbuk.co.uk/ap/

Library of Congress Cataloging-in-Publication Data
Rudin, Alfred
The elements of polymer science and engineering /Alfred Rudin.—2nd ed.
p. cm.
Includes bibliographical references and index.
ISBN-13: 978-0-12-601685-7 ISBN-10: 0-12-601685-2 (acid-free paper)
1. Polymers. 2. Polymerization.
QD381.R8 1998
547′.7—dc21 98-11623
CIP

ISBN-13: 978-0-12-601685-7
ISBN-10: 0-12-601685-2
Printed in the United States of America
05 06 MV 9 8 7 6 5 4

Copyrighted material

DOCKET ALARM
Find authenticated court documents without watermarks at docketalarm.com.

Chapter 4

Effects of Polymer Isomerism and Conformational Changes

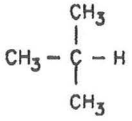
With a name like yours, you might be any shape, almost.
—Lewis Carroll, *Through the Looking Glass*

Three types of isomerism are important in macromolecular species. These involve constitutional, configurational, and conformational variations. These terms are defined and illustrated. Their usage in macromolecular science is very much the same as in micromolecular chemistry.

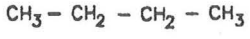
4.1 CONSTITUTIONAL ISOMERISM

The constitution of a molecule specifies which atoms in the molecule are linked together and with what types of bonds.

Isobutane (**4-1**) and *n*-butane (**4-2**) are familiar examples of constitutional isomers. Each has the molecular formula C_4H_{10} but the C and H atoms are joined differently in these two molecules. In polymers the major types of constitutional differences involve positional isomerism and branching.



4-1

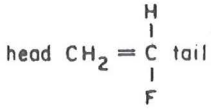


4-2

DOCKET ALARM Find authenticated court documents without watermarks at docketalarm.com.

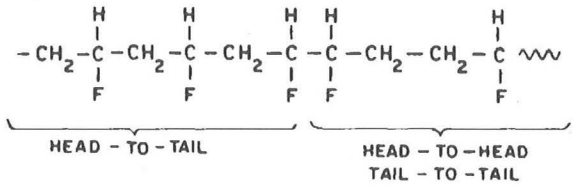
4.1.1 Positional Isomerism

Vinyl and vinylidene monomers are basically unsymmetrical because the two ends of the double bond are distinguishable (ethylene and tetrafluorethylene are exceptions). One C of the double bond can be arbitrarily labeled the head and the other the tail of the monomer, as shown in the formula for vinyl fluoride (**4-3**).



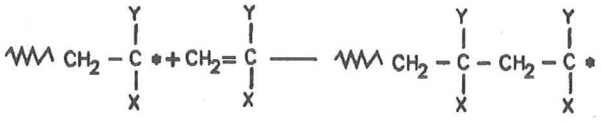
4-3

In principle, the monomer can be enchained by head-to-tail linkages or head-to-head, tail-to-tail enchainments (**4-4**). Poly(vinyl fluoride) actually has about 15% of its monomers in the head-to-head, tail-to-tail mode. This is exceptional, however. Head-to-tail enchainment appears to be the predominant or exclusive constitution of most vinyl polymers because of the influence of resonance and steric effects.



4-4

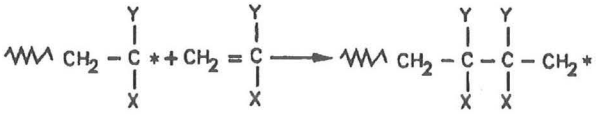
Vinyl monomers polymerize by attack of an active center (**4-5**) on the double bond. Equation (4-1) represents head-to-tail enchainment:



(4-1)

4-5 **4-6**

while Eq. (4-2) shows the sequence of events in head-to-head, tail-to-tail polymerization:



(4-2)

4-7

DOCKET ALARM Find authenticated court documents without watermarks at docketalarm.com.

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.