A User's Guide to Vacuum Technology

Third Edition

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WILEY-INTERSCIENCE

A JOHN WILEY & SONS, INC., PUBLICATION

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.
Published simultaneously in Canada.

Library of Congress Cataloging-in-Publication Data:

Library of Congress Cataloging-In-Publication Data is available:
0-471-27052-0

Printed in the United States of America.

10 9 8 7 6 5 4 3 2 1

For Jean, Carol, Paul, and Amanda

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Preface

This book is intended for the vacuum system user—the university student, technician, engineer, manager, or scientist—who wishes a fundamental understanding of modern vacuum technology and a user's perspective of modern laboratory and industrial vacuum technology.

Vacuum technology is largely secondary; it forms part of other technologies that are central to analysis, research, development, and manufacturing. It is used to provide a process environment. Many advances in vacuum technique have resulted from the demands of other technologies, although scientists and engineers have studied vacuum for its own sake. The average user is process-oriented and becomes immersed in vacuum technique only when problems develop with a process or when new equipment purchases become necessary.

A *User's Guide to Vacuum Technology, 3rd Edition* focuses on the operation, understanding, and selection of equipment for processes used in semiconductor, optics, and related technologies. It emphasizes subjects not adequately covered elsewhere, while avoiding in-depth treatments of topics interesting only to the designer or curator. Residual gas analysis is an important topic whose treatment differs from the usual explanation of mass filter theory. Components such as the turbomolecular and helium gas refrigerator cryogenic pumps are now widely used but not well understood. The discussion of gauges, pumps, and materials is a prelude to the central discussion of systems. System designs are grouped according to their function. Current designs are either single-chamber or multichamber; the details of each design are determined by the requirements of an industrial or research application.

In this edition, the discussion of gauges, pumps, and materials has been updated, where relevant, to reflect changes in practice. Spinning rotor gauges are no longer a laboratory curiosity. Ultrahigh vacuum gauges, though limited in their availability, will be a necessity in next-generation production deposition systems. Ultraclean, low dead volume metrology and valves, along with superior materials and cleaning techniques, have made contamination-free manufacturing a reality.

Ultraclean vacuum, once the domain of the researcher, is now routinely used for high-volume production of semiconductor chips and storage

media. However, methodologies for reaching low pressures in a clean manner have changed significantly. No longer are single-chamber systems baked for twenty-four hours. Rather, cassette-based load/unload chambers serve as high-volume interfaces between atmosphere and ultraclean process chambers. These chambers, which can be accessed in serial or random order, are only exposed to atmosphere during maintenance.

Large, efficient multichamber medium and highvacuum systems are used in high-speed coating of numerous consumer products such as window glass, solar cells, video tape, printer paper, eyeglass lenses, automobile headlamps, plastic films and security devices.

The gap in knowledge and training between those who manufacture and those who use vacuum equipment continues to widen. It is from this perspective that the previous edition of this book has been revised. Important formulas have been denoted with a ▶ for emphasis. Easy questions have been emphasized with a †.

Thanks are due to countless researchers who, individually and collaboratively, have advanced this field by creative solutions to real problems; I also thank Dr. Bruce Kendall for his insightful comments and thoughtful review.

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ITS BASIS

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