

 Taylor & Francis  
Taylor & Francis Group

# HANDBOOK OF OPTICAL INTERCONNECTS



EDITED BY  
SHIGERU KAWAI

Published in 2005 by  
CRC Press  
Taylor & Francis Group  
6000 Broken Sound Parkway NW, Suite 300  
Boca Raton, FL 33487-3742

© 2005 by Taylor & Francis Group, LLC  
CRC Press is an imprint of Taylor & Francis Group

No claim to original U.S. Government works  
Printed in the United States of America on acid-free paper  
0 8 8 7 6 5 4 3 2 1

International Standard Book Number-10: 0-8247-3441-0 (Hardcover)  
International Standard Book Number-13: 978-0-8247-3441-2 (Hardcover)  
Library of Congress Card Number: 2004081862

This book contains information obtained from authentic and highly regarded sources. Reprinted material is quoted with permission, and sources are indicated. A wide variety of references are listed. Reasonable efforts have been made to publish reliable data and information, but the author and the publisher cannot assume responsibility for the validity of all materials or for the consequences of their use.

No part of this book may be reprinted, reproduced, transmitted, or utilized in any form by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying, microfilming, and recording, or in any information storage or retrieval system, without written permission from the publisher.

For permission to photocopy or use material electronically from this work, please access [www.copyright.com](http://www.copyright.com) (<http://www.copyright.com>) or contact the Copyright Clearance Center, Inc. (CCC), 222 Rosewood Drive, Danvers, MA 01923, 978-750-8400. CCC is a not-for-profit organization that provides licenses and registration for a variety of users. For organizations that have been granted a photocopy license by the CCC, a separate system of payment has been arranged.

**Trademark Notice:** Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

---

#### Library of Congress Cataloging-in-Publication Data

---

Handbook of optical interconnects / edited by Shigeru Kawai.  
p. cm. — (Optical engineering ; 1, 100)

Includes bibliographical references and index.

ISBN 0-8247-3441-0 (alk. paper)

I. Optical interconnects—Handbooks, manuals, etc. I. Kawai, Shigeru, 1958- II. Optical engineering (Mascof Dekker, Inc.) ; v. 100.

Tx:wee Hw 2005  
621.3627—dc12

2004081862

---

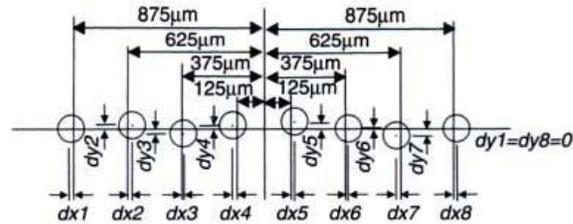
**T&F informa**

Taylor & Francis Group  
an Academic Division of T&F Informa plc

Visit the Taylor & Francis Web site at  
<http://www.taylorandfrancis.com>

and the CRC Press Web site at  
<http://www.crcpress.com>

Copyright © 2005

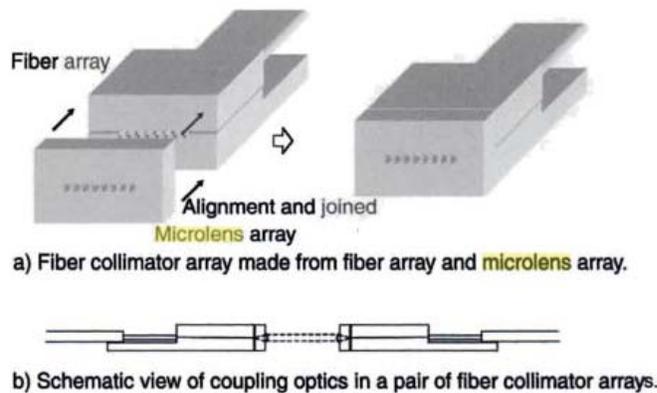


**Figure 9.25** Schematic diagram of eccentricity in 250- $\mu\text{m}$  pitch arrayed fiber.

the light going out of the fibers must be collimated using microlenses to improve the efficiency. A **microlens** array in which microlenses are arrayed accurately in the same way as in a fiber array is shown in Figure 9.26.

#### 9.6.2.1 Types of **Microlens** Arrays

**Microlens** arrays include graded index lenses fabricated by ion exchange of glass<sup>11</sup>; lenses obtained by transferring a resist pattern that exhibits a spherical shape by resist reflow



**Figure 9.26** Schematic view of coupling optics in a pair of fiber collimator arrays.