

# **Sustainable Epoxy Thermosets and Nanocomposites**



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

Names: Karak, Niranjana, editor.

Title: Sustainable epoxy thermosets and nanocomposites / Niranjana Karak,  
Tezpur University, Advanced Polymer and Nanomaterial Laboratory,  
Department of Chemical Sciences, Napaam, Tezpur, India, editor.

Description: Washington, DC : American Chemical Society, [2021] | Series:  
ACS symposium series ; 1385 | Includes bibliographical references and  
index.

Identifiers: LCCN 2021046824 (print) | LCCN 2021046825 (ebook) | ISBN  
9780841298316 (hardcover OP) | ISBN 9780841298309 (ebook other) | ISBN 9781713889007 (pod)

Subjects: LCSH: Nanocomposites (Materials) | Thermosetting composites. |  
Polymers.

Classification: LCC TA418.9.N35 S883 2021 (print) | LCC TA418.9.N35  
(ebook) | DDC 620.1/15--dc23/eng/20211109

LC record available at <https://lccn.loc.gov/2021046824>

LC ebook record available at <https://lccn.loc.gov/2021046825>

The paper used in this publication meets the minimum requirements of American National Standard for Information Sciences—Permanence of Paper for Printed Library Materials, ANSI Z39.48-1984.

Copyright © 2021 American Chemical Society

All Rights Reserved. Reprographic copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Act is allowed for internal use only, provided that a per-chapter fee of \$40.25 plus \$0.75 per page is paid to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, USA. Republication or reproduction for sale of pages in this book is permitted only under license from ACS. Direct these and other permission requests to ACS Copyright Office, Publications Division, 1155 16th Street, N.W., Washington, DC 20036.

The citation of trade names and/or names of manufacturers in this publication is not to be construed as an endorsement or as approval by ACS of the commercial products or services referenced herein; nor should the mere reference herein to any drawing, specification, chemical process, or other data be regarded as a license or as a conveyance of any right or permission to the holder, reader, or any other person or corporation, to manufacture, reproduce, use, or sell any patented invention or copyrighted work that may in any way be related thereto. Registered names, trademarks, etc., used in this publication, even without specific indication thereof, are not to be considered unprotected by law.

PRINTED IN THE UNITED STATES OF AMERICA

# Contents

<b>Preface</b> .....	<b>ix</b>
<b>1. Overview of Epoxies and Their Thermosets</b> .....	<b>1</b>
Niranjan Karak	
<b>2. Modification of Epoxies</b> .....	<b>37</b>
Niranjan Karak	
<b>3. Epoxy Biocomposites</b> .....	<b>69</b>
Niranjan Karak	
<b>4. Epoxy Nanocomposites with Silicon-Based Nanomaterials</b> .....	<b>99</b>
Niranjan Karak	
<b>5. Epoxy Nanocomposites with Graphene Derivatives</b> .....	<b>133</b>
Niranjan Karak	
<b>6. Epoxy Nanocomposites with Carbon Nanotubes</b> .....	<b>169</b>
Niranjan Karak	
<b>7. Nanocomposites of Epoxy and Carbon Dots</b> .....	<b>201</b>
Niranjan Karak	
<b>8. Nanocomposites of Epoxy and Cellulosic Nanomaterials</b> .....	<b>235</b>
Niranjan Karak	
<b>9. Nanocomposites of Epoxy and Metal Nanoparticles</b> .....	<b>267</b>
Niranjan Karak	
<b>10. Nanocomposites of Epoxy and Metal Oxide Nanoparticles</b> .....	<b>299</b>
Niranjan Karak	
<b>11. Nanocomposites of Epoxy and Other Miscellaneous Nanomaterials</b> .....	<b>331</b>
Niranjan Karak	
<b>Editor's Biography</b> .....	<b>363</b>

## Indexes

<b>Author Index</b> .....	<b>367</b>
---------------------------	------------

**Subject Index ..... 369**