

Hydrophobic and Superhydrophobic Organic-Inorganic Nanohybrids

Chang-Sik Ha
Saravanan Nagappan



Hydrophobic
and Superhydrophobic
Organic-Inorganic
Nanohybrids



Hydrophobic and Superhydrophobic Organic-Inorganic Nanohybrids

Chang-Sik Ha
Saravanan Nagappan

Published by

Pan Stanford Publishing Pte. Ltd.
Penthouse Level, Suntec Tower 3
8 Temasek Boulevard
Singapore 038988

Email: editorial@panstanford.com

Web: www.panstanford.com

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library.

**Hydrophobic and Superhydrophobic Organic-Inorganic
Nanohybrids**

Copyright © 2018 by Pan Stanford Publishing Pte. Ltd.

All rights reserved. This book, or parts thereof, may not be reproduced in any form or by any means, electronic or mechanical, including photocopying, recording or any information storage and retrieval system now known or to be invented, without written permission from the publisher.

For photocopying of material in this volume, please pay a copying fee through the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, USA. In this case permission to photocopy is not required from the publisher.

ISBN 978-981-4774-68-0 (Hardcover)

ISBN 978-1-351-20607-5 (eBook)

Contents

<i>Preface</i>	vii
1. Hybrid Materials and Surfaces	1
1.1 Introduction	1
1.2 Organic-Inorganic Hybrid Materials	3
1.3 Surface Wettability	8
2. Hydrophobic Organic-Inorganic Nanohybrids	21
2.1 Introduction	21
2.2 Synthesis of Hydrophobic Organic-Inorganic Nanohybrids	22
2.2.1 Sol-Gel Method	23
2.2.2 Emulsion Synthesis	31
2.2.3 Hydro- and Solvothermal Methods	33
2.2.4 Surface Grafting and Modifications	36
2.3 Fabrications of Hydrophobic Organic-Inorganic Nanohybrids	41
2.3.1 Spin Coating	41
2.3.2 Dip Coating	44
2.3.3 Spray Coating	46
2.3.4 The SILAR Method	49
2.3.5 Electrospinning	51
3. Applications of Hydrophobic Organic-Inorganic Nanohybrids	61
3.1 Introduction	61
3.2 Applications of Hydrophobic Organic-Inorganic Nanohybrids	61
3.2.1 Oil Spill Capture and Separation	61
3.2.2 Catalytic Application	64
3.2.3 Corrosion Resistance	68
3.2.4 Scratch Resistance	71

4. Superhydrophobic Organic-Inorganic Nanohybrids	77
4.1 Introduction	77
4.2 Synthesis of Superhydrophobic Organic-Inorganic Nanohybrids	78
4.2.1 Click Chemistry	78
4.2.2 Emulsion Synthesis	81
4.2.3 Surface Grafting and Modifications	88
4.3 Fabrications of Superhydrophobic Organic-Inorganic Nanohybrids	90
4.3.1 Chemical Routes	91
4.3.1.1 Self-assembly	91
4.3.1.2 Sol-gel method	94
4.3.1.3 Solution immersion	100
4.3.1.4 Electrochemical deposition	106
4.3.2 Physical Routes	109
4.3.2.1 Spray coating	109
4.3.2.2 Spin coating	113
4.3.2.3 Drop coating	115
4.3.2.4 Electrospinning	119
4.3.2.5 Plasma treatment	122
5. Applications of Superhydrophobic Organic-Inorganic Nanohybrids	137
5.1 Introduction	137
5.2 Applications of Superhydrophobic Organic-Inorganic Nanohybrids	137
5.2.1 Oil Sorption and Separation	137
5.2.2 Anticorrosion	143
5.2.3 Anti-icing	147
5.2.4 Antifouling Coatings	150
5.2.5 Photocatalysis	154
Summary and Outlook	165
<i>Index</i>	167

Preface

Organic-inorganic hybrid materials are used in various applications because of the presence of dual, enhanced chemical, thermal, and mechanical properties of organic and inorganic materials in a single material. Hybrid materials can be created by combining either an inorganic source to an organic material or an organic source to an inorganic material. In both ways, the material's properties can be improved. Enhanced hybrid materials possess more technical advantages compared to single organic or inorganic materials. Their surface properties can be classified into superhydrophilic, hydrophilic, hydrophobic, or superhydrophobic properties, depending on their surface nature and adhesion performance in relation to water (surface tension of water = 72.0 mN/m).

The technical advantages and some potential applications of organic-inorganic hybrid materials have already been covered by several scientific papers, reviews, and books. Our book, however, exclusively covers hydrophobic and superhydrophobic surfaces based on organic-inorganic nanohybrids, their synthesis and fabrication, and their recent and potential applications in various fields. The book will be a valuable guide for graduate students and scientists who have a background in chemistry, chemical engineering, materials science and engineering, nanotechnology, surface science and engineering, and industrial coating applications.

We would like to express our sincere gratitude to Pan Stanford Publishing for offering us the opportunity to publish this book. We would also like to acknowledge the support given by our former and present researchers in the Nano-Information Materials Laboratory, Pusan National University, Republic of Korea, in bringing out this book.

Chang-Sik Ha and Saravanan Nagappan

Pusan National University

2018

