

University of Groningen

## Biomedical Applications of Nanodiamonds in Microbiology

Norouzi, Neda

DOI:  
[10.33612/diss.250888650](https://doi.org/10.33612/diss.250888650)

**IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.**

*Document Version*  
Publisher's PDF, also known as Version of record

*Publication date:*  
2022

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*  
Norouzi, N. (2022). *Biomedical Applications of Nanodiamonds in Microbiology*. [Thesis fully internal (DIV), University of Groningen]. University of Groningen. <https://doi.org/10.33612/diss.250888650>

### Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

### Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

# **Biomedical Applications of Nanodiamonds in Microbiology**

**Neda Norouzi**

Book Cover : **Dutch Pouring Art (by Neda Norouzi)**

Printed by : **Gildeprint, Enschede**



university of  
 groningen



Ferdowsi University  
 of Mashhad

# Biomedical Applications of Nanodiamonds in Microbiology

**PhD thesis**

to obtain the degree of PhD at the  
 University of Groningen  
 on the authority of the  
 Rector Magnificus Prof. C. Wijmenga  
 and in accordance with  
 the decision by the College of Deans.

and

to obtain the degree of PhD at the  
 Ferdowsi University of Mashhad  
 on the authority of the  
 Rector Magnificus Prof. A. Zabeti  
 and in accordance with  
 the decision by the College of Deans.

Double PhD degree

This thesis will be defended in public on

Wednesday 23 November 2022 at 12.45 hours

by

**Neda Norouzi**  
 born on 18 June 1989  
 in Khash, Iran

## **Supervisors**

Prof. R. Schirhagl

Prof. M. B. Habibi Najafi

## **Assessment Committee**

Prof. J. Meijer

Prof. C.H. van der Wal

Prof. P. Olinga

*I dedicate this work of mine  
To my loving husband, **Reza**.  
For his endless love, support, and encouragement  
Through times, hard and fraught with turbulence  
He patiently stood by  
Cheering, comforting... hardly ever the whine.*

*And To  
Those who surrounded me  
with their love and support  
in my life's storms.*

## **Paranymphs**

Taraneh Mokabber

Mahsa Kaveh

## **Table of content**

<b>Chapter I</b> – General Introduction.....	1
<b>Chapter II</b> – Effect of medium and aggregation on antibacterial activity of nanodiamonds.....	13
<b>Chapter III</b> – Relaxometry for Detecting Free Radical Generation During Bacteria’s Response to Antibiotics.....	41
<b>Chapter IV</b> – Antimicrobial studies of black silicon and black diamond using Gram-positive bacteria.....	67
<b>Chapter V</b> – General discussion.....	91
<b>Summary</b> .....	103
<b>Samenvattig</b> .....	107
<b>Acknowledgment</b> .....	111
<b>About the author</b> .....	117
<b>Publications</b> .....	119



