

TABLE OF CONTENTS

RATIFICATION PAGE	ii
PLAGIARISM-FREE STATEMENT	iii
DEDICATION PAGE	iv
PREFACE	v
TABLE OF CONTENTS	vi
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF APPENDICES	xi
ABSTRACT	xii
INTISARI	xiii
CHAPTER I INTRODUCTION	1
I.1 Background	1
I.2 Research Objectives	3
I.3 Research Benefits	3
CHAPTER II LITERATURE REVIEW AND HYPOTHESES	4
II.1 Literature Review	4
II.1.1 Silica nanoparticle	4
II.1.2 Biosensor	7
II.1.3 Fluorescence properties in nanomaterials	8
II.1.4 Cadmium selenide (CdSe) quantum dots	9
II.1.5 Cancer detection using chemical materials	10
II.1.6 MCF-7 and MUC-1 in cancer detection	13
II.2 Hypotheses Formulation	14
II.2.1 Formulation of hypothesis 1	14
II.2.2 Formulation of hypothesis 2	14
II.2.3 Formulation of hypothesis 3	15
II.2.4 Formulation of hypothesis 4	15
II.2.5 Research Design	15
CHAPTER III METHODS	17
III.1 Materials	17
III.2 Equipment	17
III.3 Research Procedure	17
III.3.2 Geothermal Silica-Based Nanoparticles Synthesis	18
III.3.3 Commercial Silica-Based Nanoparticles Synthesis	19
III.3.4 Surface Modification Using Quantum Dots	19
III.3.5 Fluorescence Stability Test	20
III.3.6 Conjugation Using Antibody MUC-1	21
III.3.7 MCF-7 Cell Line Detection	21
CHAPTER IV RESULTS AND DISCUSSION	23
IV.1 Silica Nanoparticles from Geothermal Silica	23
IV.2 Silica Nanoparticles from TEOS	25
IV.3 Quantum Dots Modified Silica Nanoparticles	27
IV.4 MUC-1 Modified Silica Nanoparticles	34
IV.5 MCF-7 Detection	38



UNIVERSITAS
GADJAH MADA

**CdSe QUANTUM DOTS MODIFIED GEOTHERMAL SILICA-BASED NANOSENSOR FOR MCF-7
BREAST CANCER CELL DETECTION**

Anastasya Erica Airyn, Fajar Inggit Pambudi, S.Si., M.Sc., Ph.D.; Siti Nurul Aisyiyah Jenie, Ph.D

Universitas Gadjah Mada, 2023 | Diunduh dari <http://etd.repository.ugm.ac.id/>

CHAPTER V CONCLUSION AND SUGGESTION	43
V.1 Conclusion	43
V.2 Suggestion	44
REFERENCES	45

LIST OF TABLES

Table III.1 Sample codes of the materials	20
Table III.2 Sample codes of the anti-MUC-1 conjugated materials	21
Table III.3 Sample codes in well plate	22
Table IV.1 BET Results for SiNP G	24
Table IV.2 BET Results for SiNP G	26
Table IV.3 MUC-1 antibody concentration variations	37
Table IV.4 Sample codes in well plate	39

LIST OF FIGURES

Figure II.1	The structure of SiO ₂ structure synthesized from TEOS	4
Figure II.2	FTIR result of silica synthesized using Stöber method under addition of CaCl ₂ (CC), Ca(NO ₃) ₂ (CN), Ca(OMe) ₂ (CM), and Ca(OTe) ₂ (CE)	5
Figure II.3	Reverse microemulsion silica nanoparticles with surfactant (a) TX-100, (b) CTAB, and (c) SDS under SEM analysis	6
Figure II.4	Antibody immobilization scheme using (A) EDC/NHS, (B)TCEP or 2-MEA in gold materials, and (C) periodate oxidation	8
Figure II.5	Jablonski diagram	8
Figure II.6	Stability test of quantum dots with various coating agents	9
Figure II.7	Fluorescence microscopies result for various cell lines modified with CdSe/ZnS with various synthesis conditions	10
Figure II.8	Reaction scheme of HER-2 conjugation by modified APTES/MoO ₃ @RGO/ITO	11
Figure II.9	Fluorescence spectroscopy analysis of HT1299 cells with multiple colorants	12
Figure II.10	Microscope analysis (a1, b1, and c1) and fluorescence microscope analysis (a2, b2, and c2) of MCF-7 cell line conjugated with different materials	12
Figure II.11	Microscope analysis of MCF-7	13
Figure II.12	Structure of MUC-1 gene	14
Figure III.1	Work flowchart of SiNP G	18
Figure III.2	Work flowchart of SiNP T	18
Figure IV.1	Adsorption desorption graph for SiNP G	24
Figure IV.2	Adsorption desorption graph for SiNP G	25
Figure IV.3	Adsorption desorption graph for SiNP T	26
Figure IV.4	Adsorption desorption graph for SiNP T	27
Figure IV.5	UV lamp observation of (from left to right) SiNP G, SiNP G@QD 125, SiNP G@QD 250, SiNP G@QD 500, and SiNP G@QD 1 (A) & SiNP T, SiNP T@QD 125, SiNP T@QD 250, SiNP T@QD 500, and SiNP T@QD 1 (B) under a wavelength of 366 nm	27
Figure IV.6	Silanization of SiNP	28
Figure IV.7	Reaction of SiNP-APTES and carboxyl-based quantum dots	28
Figure IV.8	Adsorption desorption graph for SiNP T	29
Figure IV.9	UV-Vis for SiNP G@QD	30
Figure IV.10	Fluorescence spectroscopy result for SiNP G@QD 125 µg/mL (A), 250 µg/mL (B), 500 µg/mL (C), and 1 mg/mL (D)	31
Figure IV.11	Fluorescence spectroscopy result for SiNP T@QD 125 µg/mL (A), 250 µg/mL (B), 500 µg/mL (C), and 1 mg/mL (D)	32
Figure IV.12	Stability test of SiNP G@QD	33
Figure IV.13	Stability test of SiNP T@QD	34

Figure IV.14	Reaction scheme of the immobilization of anti-MUC-1 antibody	35
Figure IV.15	FTIR result for SiNP G@QD@Ab and SiNP T@QD@Ab at wavenumber 500–4000 cm^{-1} (A) and 1250–4000 cm^{-1} (B)	36
Figure IV.16	FTIR result for SiNP G@QD@Ab variations at wavenumber 500–4000 cm^{-1} (A) and 1250–4000 cm^{-1} (B)	38
Figure IV.17	Microscopic result of cultured MCF-7 (A) and cultured MCF-7 with SiNP@QD@Ab (B)	39
Figure IV.18	Fluorescent analysis result of the detection process	40
Figure IV.19	Absorbance analysis result of the detection process	40
Figure IV.20	Fluorescence analysis result of the detection process at excitation 360 nm	41
Figure IV.21	Absorbance analysis result of the detection process	42
Figure IV.22	Fluorescence analysis result of Treated variations and SiNP G@QD@Ab in the detection process	42

LIST OF APPENDICES

Appendix 1 Calculation	51
Appendix 2 BET SAA	52
Appendix 3 FTIR	56
Appendix 4 MCF-7 Detection	65
Appendix 5 Documentation	67