DESIGN, FABRICATION AND CHARACTERIZATION OF CMOS ISFET FOR pH MEASUREMENTS

CHIN SENG FATT

UNIVERSITI MALAYSIA PERLIS
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DESIGN, FABRICATION AND
CHARACTERIZATION OF CMOS ISFET
FOR pH MEASUREMENTS

by

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(0630110086)

A thesis submitted
in fulfillment of the requirements for the degree of
Master of Science (Microelectronic Engineering)

School of Microelectronic Engineering
UNIVERSITI MALAYSIA PERLIS

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DECLARATION OF THESIS

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List of Abbreviations

Al Aluminium
Al₂O₃ Aluminium Oxide
Ag/AgCl Argentum/ Argentum Chloride (Silver/Silver Chloride)
BSC Back sided contact
BOE Buffered Oxide Etch
Ca²⁺ Calcium ion
ChemFET Chemically modified field effect transistor
CMOS Complementary Metal Oxide Semiconductor
CAD Computer Aided Design
I-V Current-Voltage
DIW Deionised Water
DUT Device Under Test
DC Direct Current
FET Field Effect Transistor
FIA Flow injection analysis
HDL Hardware Description Language
H⁺ Hydrogen ion
IGFET Insulated Gate Field Effect Transistor
ISE Ion sensitive electrode
ISFET Ion Sensitive Field Effect Transistor
K⁺ Kalium ion
Hg Mercury
Hg₂Cl₂ Mercury Chloride
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<tr>
<td>MIS</td>
<td>Metal Insulator Semiconductor</td>
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<td>MOSFET</td>
<td>Metal Oxide Semiconductor Field Effect Transistor</td>
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<td>MNOS</td>
<td>Metal-nitride-oxide-semiconductor</td>
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<td>MFCL</td>
<td>Micro Fabrication Cleanroom Laboratory</td>
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<td>µTAS</td>
<td>Micro total analysis system</td>
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<td>Na⁺</td>
<td>Natrium ion</td>
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<td>NMOS</td>
<td>N-channel MOSFET</td>
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<td>O₂</td>
<td>Oxygen (gas)</td>
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<td>PMOS</td>
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<td>PVD</td>
<td>Physical Vapour Deposition</td>
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<td>PECVD</td>
<td>Plasma Enhanced Chemical Vapour Deposition</td>
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<td>pCO₂</td>
<td>Power of carbon dioxide</td>
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<td>pH</td>
<td>Power of hydrogen</td>
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<td>PCB</td>
<td>Printed Circuit Board</td>
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<td>QC</td>
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<td>rpm</td>
<td>Revolution per minute</td>
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<td>Semiconductor Parameter Analyzer</td>
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<td>Si</td>
<td>Silicon</td>
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<td>SiO₂</td>
<td>Silicon dioxide or Silicon oxide or Oxide</td>
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<td>Si₃N₄</td>
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<td>SPICE</td>
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<td>SnO₂</td>
<td>Stanum oxide</td>
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Ta$_2$O$_5$  Tantalum pentoxide
TCAD  Technology Computer Aided Design
TAT  Turn around time
VHDL-AMS  Very-High-Speed-Integrated-Circuit Hardware Description Language (VHDL)-Analog and Mixed Signal (AMS)
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<td>$I_D$</td>
<td>Drain current</td>
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<td>$V_D$</td>
<td>Drain voltage</td>
<td>V</td>
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<td>$V_G$</td>
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<td>$V_{TH}$</td>
<td>Threshold Voltage</td>
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<tr>
<td>$b$</td>
<td>Width of Area</td>
<td>µm</td>
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<tr>
<td>$L$</td>
<td>Length of Area</td>
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<td>$\mu_n$</td>
<td>Electron mobility in a channel</td>
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<td>$C_0$</td>
<td>Oxide capacitance per unit area</td>
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<td>$V_{DSAT}$</td>
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