

**SELECTIVE ESTERIFICATION OF GLYCEROL WITH  
LAURIC ACID TO MONOLAURIN USING  
12-TUNGSTOPHOSPHORIC ACID INCORPORATED SBA-15**

**by**

**HOO PENG YONG**

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## LIST OF ABBREVIATIONS

AAS	Atomic absorption spectroscopy
ANOVA	Analysis of Variance
AT-GMB	Activated Bentonite
BET	Brunauer–Emmett–Teller
CaOH <sub>2</sub>	Calcium Hydroxide
DoE	Design of Experiment
DS	Direct Synthesis Method
EDS	Energy Dispersive X-ray Spectroscopy
FAME	Fatty Acid Methyl Ester
FTIR	Fourier Transformed Infrared
GC	Gas Chromatograph
GCMS	Gas Chromatograph Mass Spectrometer
H <sub>2</sub> O	Water
H <sub>2</sub> SO <sub>4</sub>	Sulfuric Acid
HCl	Hydrochloric Acid
HMS	Hexagonal Mesoporous Silica
HPA	Heteropoly Acids
HRTEM	High Resolution Transmission Electron Microscopy
HPW	12-tungstunphosphoric Acid
IM	Post Impregnation Method
KOH	Potassium Hydroxide
MMSs	Mesoporous Molecular Sieves
MPA	Molybdophosphoric acid
MPMDS	3-mercaptopropiyl (methyl) dimethoxy silane
MPTMS	3-mercaptopropyl trimethoxy silane

NaOH	Sodium Hydroxide
NH <sub>3</sub>	Ammonia
NH <sub>3</sub> -TPD	Temperature Programmed Desorption with Ammonia
P	Phosphorus
P123	Pluronic 123
R	Long Straight Carbon Chain
R	Alcohol to Fatty Acid Molar Ratio
RSM	Response Surface Methodology
SBA-15	Santa-Barbara Amorphous No. 15
SEM	Scanning Electron Microscopy
T	Temperature
t	Time
TEM	Transmission Electron Microscopy
TEOS	Tetraethylorthosilicate
TGA	Thermal Gravimetric Analysis
TOF	Turnover Frequency
TON	Turnover Number
W	Tungsten
XDR	X-ray Diffraction
XPS	X-ray photoelectron spectroscopy

## LIST OF SYMBOLS

2-D	2-dimensional
3-D	3-dimensional
Å	Angstrom
cm <sup>3</sup>	Cubic centimetre
°C	Degree centigrade
Cal	Calorie
E <sub>a</sub>	Activation energy
g	Gram
h/ hr	Hour
J	Joule
k	kilo
K	Kelvin
k <sub>-1</sub>	Backward reaction rate constant
K <sub>+1</sub>	Forward reaction rate constant
Pa	Pascal
m <sup>2</sup>	Square meter
ml	Millilitre
min	Minutes
mol	moles
n	Order of reaction
T	Temperature
wt%	Weightage percentage