

**MINISTRY OF EDUCATION AND TRAINING
HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY**

NGUYEN THE TIEN

**SYNTHESIZE AND INVESTIGATE THE CATALYTIC ACTIVITY OF
THREE-WAY CATALYSTS BASED ON MIXED METAL OXIDES
FOR THE TREATMENT OF EXHAUST GASES FROM
INTERNAL COMBUSTION ENGINE**

CHEMICAL ENGINEERING DISSERTATION

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Nguyen The Tien

September 2013

COMMITMENT

I assure that this is my own research. All the data and results in the thesis are completely true, was agreed to use in this paper by co-author. This research hasn't been published by other authors than me.

Nguyen The Tien

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ABBREVIATION

TWCs: Three-Way Catalysts

NO_x: Nitrous Oxides

VOCs: Volatile Organic Compounds

PM10: Particulate Matter less than 10 nm in diameter

NMVOCs: Non-Methane Volatile Organic Compounds

HC: hydrocarbon

A/F ratio: Air/Fuel ratio

λ : the theoretical stoichiometric value, defined as ratio of actual A/F to stoichiometric; λ can be calculated $\lambda = (2O_2 + NO) / (10C_3H_8 + CO)$; $\lambda = 1$ at stoichiometry (A/F = 14.7)

SOF: Soluble Organic Fraction

DPM: Diesel Particulate Matter

CRT: Continuously Regenerating Trap

NM: Noble Metal

Cpsi: Cell Per Inch Square

In.: inch

CZ (Ce-Zr): mixtures of CeO₂ and ZrO₂

CZALa: mixtures of CeO₂, ZrO₂, Al₂O₃, La₂O₃

NGVs: natural gas vehicles

OSC: oxygen storage capacity

WGS: water gas shift

LNTs: Lean NO_x traps

NSR: NO_x storage-reduction

SCR: selective catalytic reduction

SG: sol-gel

MC: mechanical

FTIR: Fourier-Transform Infrared

Eq.: equation

T₁₀₀: the temperature that correspond to the pollutant was completely treatment

T_{max}: The maximum peak temperature was presented as reference temperature of the maximum reaction rate in TG-DTA (DSC) diagram

Vol.: volume

Wt. : weight

Cat: catalyst

at: atomic

min.: minutes

h: hour

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