



The Potential of Bifunctional Acid-Base $\text{Bi}_2\text{O}_3/\text{ZrO}_2$ Heterogeneous Catalyst for Conversion of Microalgae Lipid to Biodiesel

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Background

Biodiesel is an attractive alternative source of energy owing to its renewability, biodegradability, sustainability, and non-toxicity. Today, there has been growing research interest in using microalgae as biodiesel feedstock because of its rapid growth rate, high photosynthetic efficiency, high oil contents, and the minimum space required for cultivation.

Problem Statement

- ❖ Microalgae contains high free fatty acid content
- ❖ The process generally requires a two-step reaction:

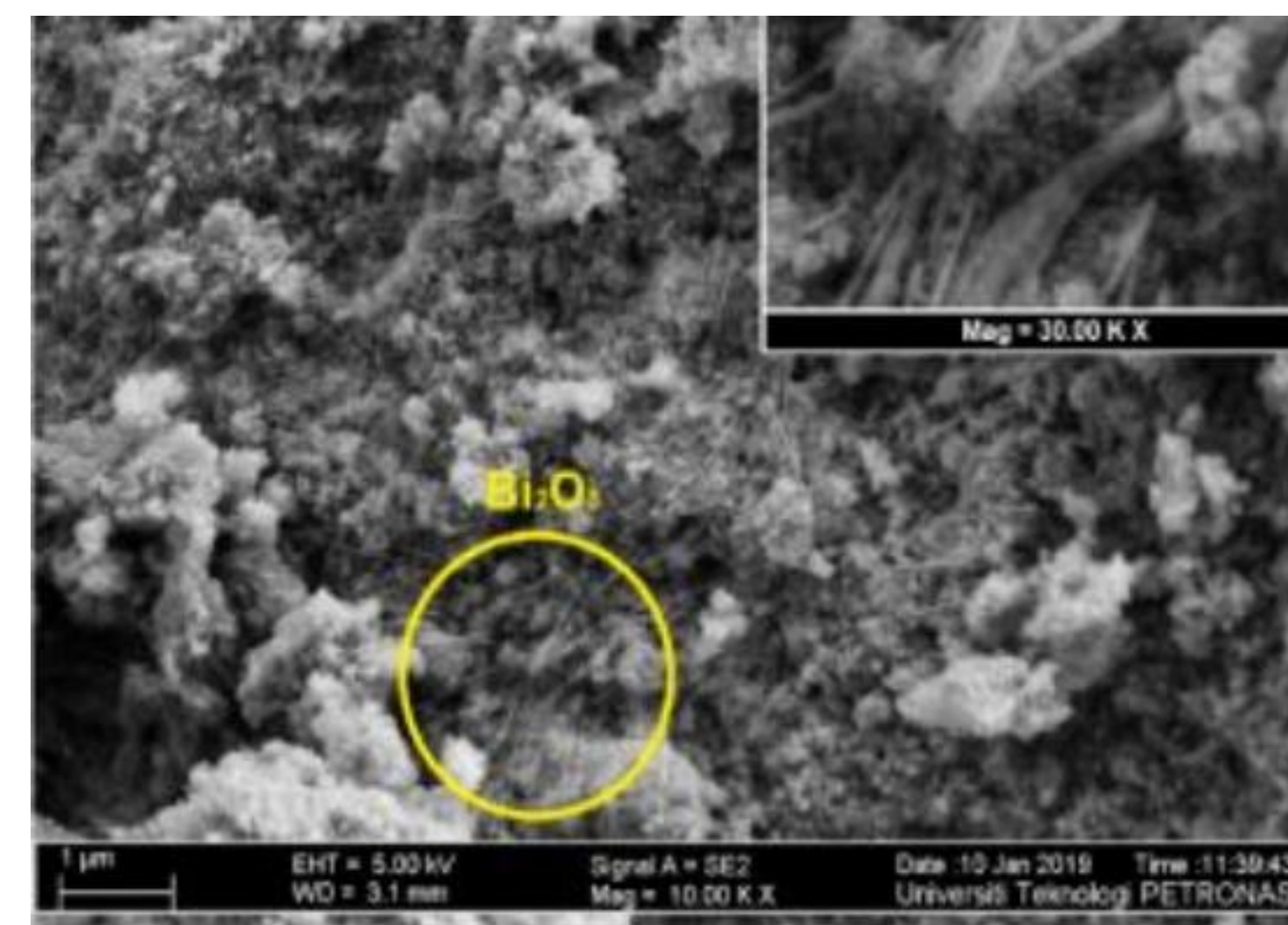
1- esterification of free fatty acid using an acid catalyst to avoid saponification problem

2- transesterification of lipid to biodiesel using a base catalyst due to it requires short reaction time and low reaction temperature.

Objective

To synthesize bifunctional acid-base $\text{Bi}_2\text{O}_3/\text{ZrO}_2$ heterogeneous catalysts which offers simplicity of continuous biodiesel production method over batch method.

Results

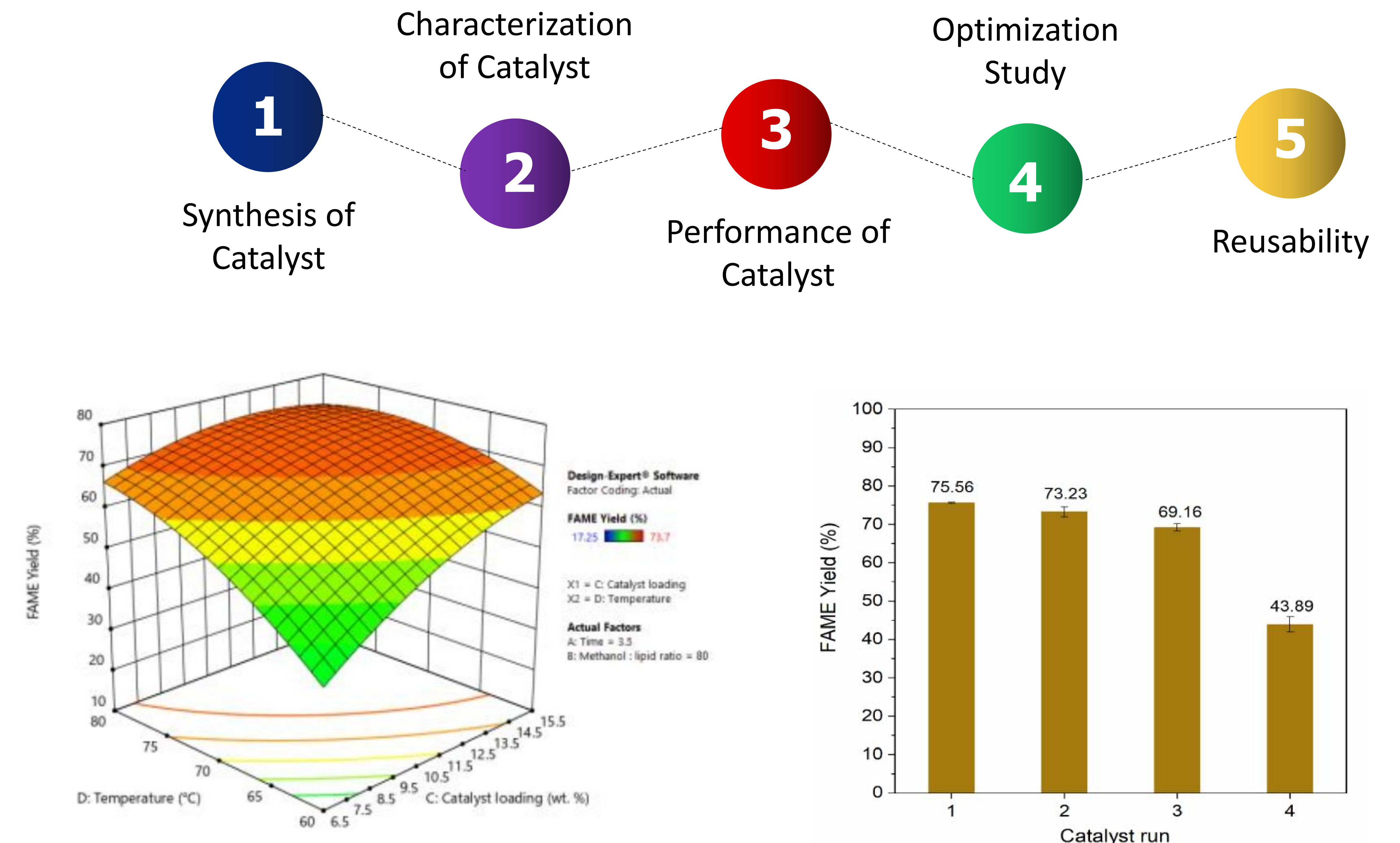


$\text{Bi}_2\text{O}_3/\text{ZrO}_2$ Heterogeneous Catalyst

- ❖ Surface area: $157 \text{ m}^2/\text{g}$
- ❖ Total acidic sites: 17.38 mmol/g
- ❖ Total basic sites: 4.36 mmol/g

Properties	Units	<i>Nannochloropsis</i> sp. biodiesel
Saturated FAME	%	57.87
Monounsaturated FAME	%	28.50
Polyunsaturated FAME	%	10.03
Acid value	mg KOH g^{-1}	0.63
Total glycerol	wt. %	0.10

Methodology



Optimum conditions:

Methanol to microalgae lipid ratio: 48:1; catalyst loading: 15 wt.%; temperature: 77°C ; duration: 4 h

Conclusion

- ❖ $\text{Bi}_2\text{O}_3/\text{ZrO}_2$ acts as a good catalyst to produce biodiesel from microalgae lipid and capable of being used for three times
- ❖ 75.56% FAME yield was achieved using 48:1 methanol to oil ratio, 15 wt.% catalyst loading at 77°C for 4 h

