


Supplementary Information

Simple Niobium Catalysts Applied in Reflux and Ultrasound-Assisted Systems for Biofuel Synthesis

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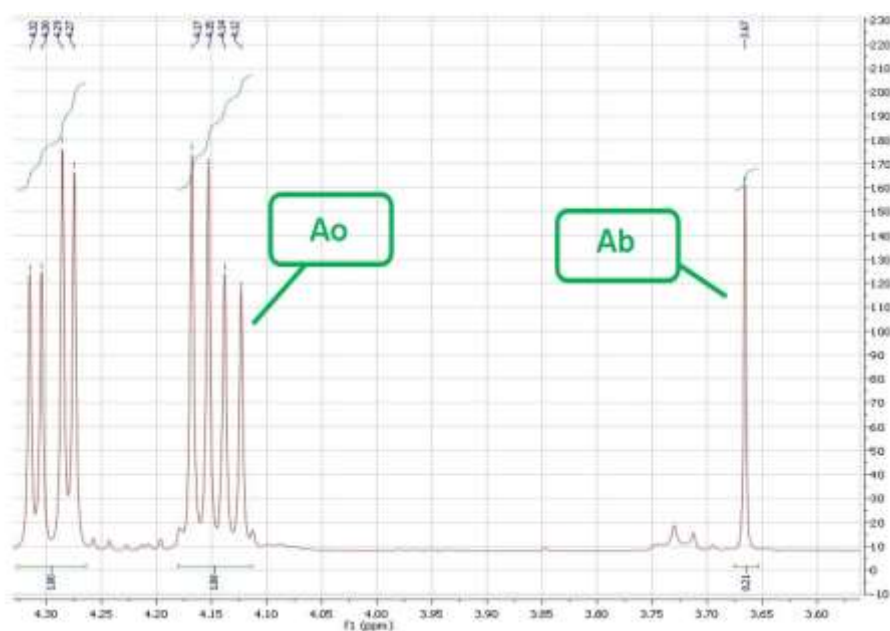


Figure S1. ¹H NMR spectrum (400 MHz, CDCl₃ with 1% TMS) showing the Ao (oil's peaks) and Ab (biodiesel peak) peaks of methyl biodiesel mixture with soybean oil using Nb₂O₅.nH₂O with 300 °C heat treatment and 100% mass proportion.

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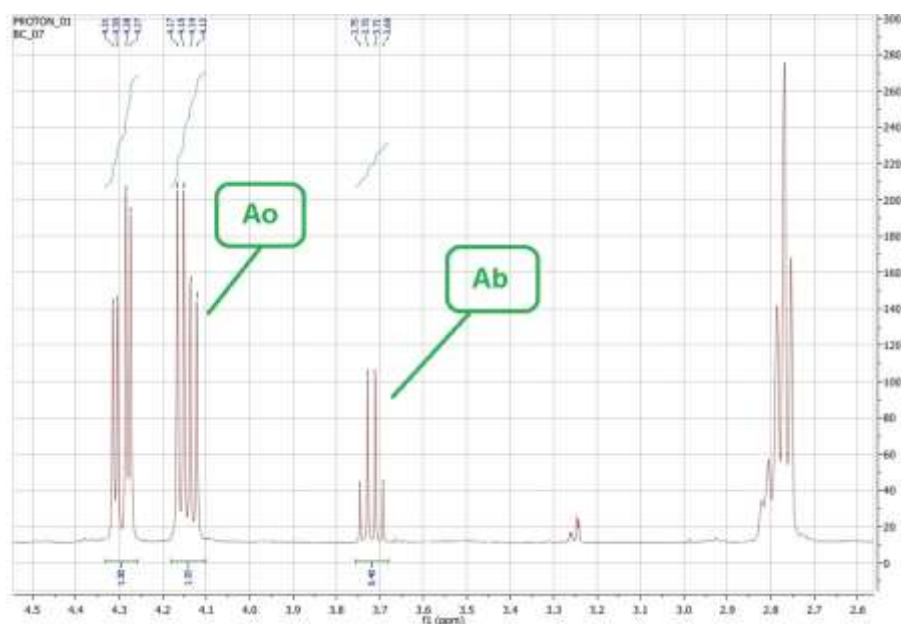


Figure S2. ^1H NMR spectrum (400 MHz, CDCl_3 with 1% TMS) showing the Ao and Ab peaks of ethyl biodiesel mixture with soybean oil using $\text{NH}_4[\text{NbO}(\text{C}_2\text{O}_4)_2(\text{H}_2\text{O})_x] \cdot n\text{H}_2\text{O}$ with 100% mass proportion to oil in a reflux system.

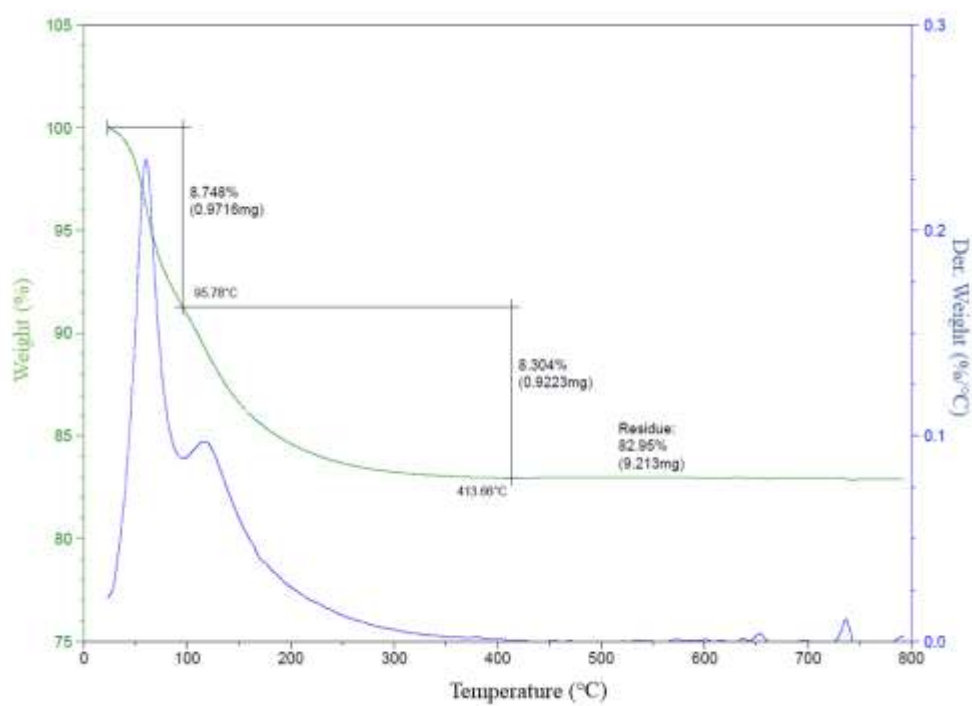


Figure S3. Thermal analysis of Nb_2O_5 under a synthetic air atmosphere with heating of $10\text{ }^\circ\text{C min}^{-1}$.

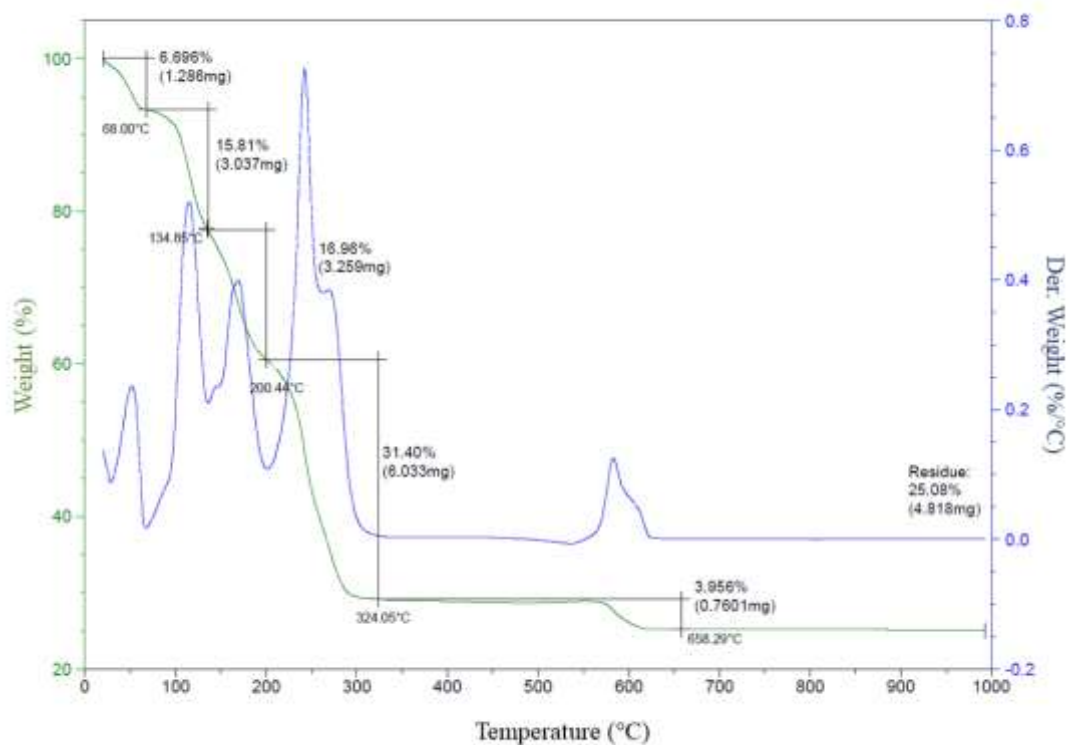
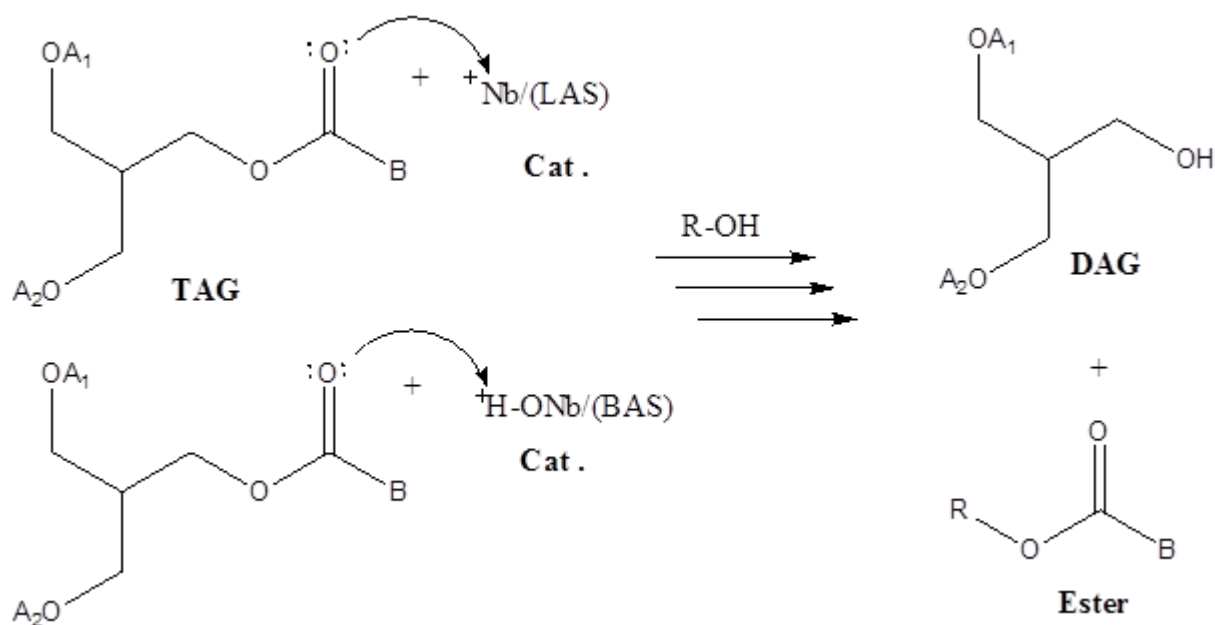


Figure S4. Thermal analysis of AmNO under a synthetic air atmosphere with heating of $10\text{ }^{\circ}\text{C min}^{-1}$.



Scheme S1. Possible catalytic pathways (LAS or BAS) at first step of transesterification reactions from TAG and alcohol (R-OH) to DAG and the corresponded ester.