MINISTRY OF EDUCATION AND TRAINING **VIETNAM NATIONAL CHEMICAL GROUP**
VIETNAM INSTITUTE OF INDUSTRIAL CHEMISTRY

INFORMATION PAGE ABOUT THE THESIS'S ACADEMIC CONTRIBUTIONS

1. Full name of PhD student: Pham Thi Hoa

2. Names of Academic Advisors: Assoc. Prof. Dr. Nguyen Thanh Binh

Dr. Dang Thi Thuy Hanh

3. Thesis title: **Synthesis of Me-O-W (Me: Si, Ti, Zr) catalysts and investigation of its catalytic activitiy for the conversion reaction of fructose into 5-hydroxymethylfurfural**

4. Thesis Field of Study: Chemistry
5. Major: Organic Chemistry
6. Course: 2017 - 2021
7. Code: 9.44.01.14
8. Institution: Vietnam Institute of Industrial Chemistry

NEW CONTRIBUTIONS OF THE THESIS

1. Metal-tungsten-mixed oxide (Me-O-W) catalysts (Me: Zr, Ti, Si) with different Me/W ratios were successfully synthesized for the first time by the sol-gel method with precursors WCl_6 and $Si(OC_2H_5)_4$, $Ti(OC_4H_9)_4$, $ZrOCl_2$.

2. Structural characterization analyses have revealed the formation of well-dispersed WO_x nanoclusters, with diameters ranging from 1 to 2 nanometers, achieved through the utilization of the sol-gel method. Notably, this uniform dispersion is particularly pronounced in the case of the Zr_9W_1 catalyst, where agglomeration into larger particles is conspicuously absent. The

study also showed the advantage of forming nanocluster phases on the oxide base using sol-gel method compared to the catalysts prepared by conventional impregnation method.

3. The conversion of fructose into hydroxymethylfurfural (HMF) using Me-W-O catalysts was systematically studied. As the results, Zr_9W_1 synthesized using sol-gel method shows exceptionally high HMF conversion (95.8%), outperformed the catalytic activity of the impregnation method prepared counterpart (only 81.6%). Surprisingly, the HMF conversion performance of sol-gel synthesized Zr_9W_1 surpasses the previously reported catalysts.

4. The optimal HMF conversion reaction condition is investigated. The optimized condition is 5 wt% of fructose in DMSO solvent with the presence of 100 mg of catalyst at 120^{o}C for 2 hours.

Academic Advisor 1	Academic Advisor 2	PhD. Student
Assoc. Prof. Dr. Nguyen Thanh Binh	**Dr. Dang Thi Thuy Hanh**	**Pham Thi Hoa**