# CHAPTER V
# CONCLUSIONS AND RECOMMENDATIONS

TUD-1 and Pd-TUD-1 mesoporous materials were successfully synthesized via sol-gel and impregnation techniques, respectively. TUD-1 and Pd-TUD-1 had a pore diameter around 4 nm, but the surface area decreased from 800 to 500 $m^2/g$ after loading Pd species on the TUD-1 support. The catalytic activity of Pd-TUD-1 on Suzuki coupling reaction showed that the best reaction time to induce the Suzuki coupling reaction was 10 min. Moreover, the best percent weight of Pd loaded on TUD-1 was 5% to give the highest % conversion which is 20% of the substrate to the products. That means, TUD-1 could be used to support Pd species for the Suzuki coupling reaction. However, to make Pd-TUD-1 an effective catalyst for the Suzuki reaction, we need to adjust the solvent and to control the Pd species to $Pd^{(0)}$ form which is the most active for the Suzuki coupling reaction.

## Recommendations

1. Other characterization techniques that need small amount of sample should also be used to determine the percent weight of Pd loaded on the TUD-1 support. For example, Atomic absorption spectroscopy and X-ray photoelectron spectroscopy are more suitable for studying more accurate percent weight of Pd species than the X-ray fluorescence (XRF), which needs much more amount of Pd-TUD-1.
2. Other types of Pd precursor should be used in place of $Pd(NO_3)_2$ since $Pd(NO_3)_2$ used in this work was dissolved in nitric acid and the Suzuki reaction works well in base. Moreover the Suzuki reaction also works well when ligands of Pd are more electron rich and bulkier which can stabilize the Pd metal in the form of $Pd^{(0)}$. In addition, the use of water or the mixture of water and other solvents in Suzuki reaction might improve the yield of the products.