

## CHAPTER 4

### CONCLUSIONS

This research was focused on the synthesis of 20% Pt-base ternary catalysts on two types of carbon for PEMFC cathode with three methods. The catalysts in the first group were prepared as 20% Pt-Co-Cr (2:1:1) supported on treated or untreated carbon vulcan XC-72 by microwave and NaBH<sub>4</sub> reduction methods. It was found that the Pt-Cr<sub>2</sub>O<sub>3</sub> was prepared by microwave method and Pt-CoO-Cr<sub>2</sub>O<sub>3</sub> was prepared NaBH<sub>4</sub> reduction method. The Pt-CoO-Cr<sub>2</sub>O<sub>3</sub> catalyst prepared by NaBH<sub>4</sub> reduction method on treated carbon Vulcan XC-72 showed a good dispersion, smaller particle size and higher performance than other prepared catalysts in this group. Second group, catalysts were prepared as 20% Pt-Co-M (M=Cu, Cr, Fe and Ni) (2:1:1) supported on treated carbon N115 by reflux method. It was found that only PtCoCuNi2 catalyst was confirmed the PtCoCu alloy phases. For the single testing, the PtCoCuNi2 performed higher performance than standard catalysts comparing per mole platinum. Final group catalysts were prepared as 20% Pt-Cu-Ni (2:1:1 and 6:1:1) supported on treated carbon Vulcan XC-72 and N115 by microwave, reflux and NaBH<sub>4</sub> reduction methods. It was found that the catalysts prepared by microwave method were Platinum-obtained phase on both carbon types which the catalysts prepared by reflux and NaBH<sub>4</sub> reduction methods obtained PtCuNi alloy on both composition and both carbon types. The PtCuNi6Ni showed higher performance than other catalysts in this group. This research was finally concluded that the PtCuNi6Ni was the highest performance catalyst at the current as 54.07 kA/cm<sup>2</sup>.mol<sub>Pt</sub> where the voltage was 600 mV.