

## CHAPTER V

### CONCLUSION

The porosity of interconnected macroporous structure is increased by gas activation and gas activation with metals loading.

#### 5.1 Gas activations

Activation with CO<sub>2</sub> and steam is studied. Both CO<sub>2</sub> and steam effect on microporosity development. The bi – modal (micropore – macropore) of pore structure is obtained after activation. The effect of activation patterns is also studied in this work. One step activation shows higher porosity development than two step activation. So that the carbonization step is not required in activated RF carbon preparation.

#### 5.2 Gas activation with metals loading

RF gel is impregnated with sodium and potassium, and activation under CO<sub>2</sub> atmosphere. From SEM images it is obviously shown that the low porosity may come from the blockage of pores on the interconnected macroporous structure by the crystals after activation. The impregnation of RF gel with cesium is not suitable for activated RF carbon preparation due to the impregnated RF gel cannot be retained in monolith form.

On the contrary, calcium impregnation on RF gel together with CO<sub>2</sub> activation has a great effect on mesoporosity development. The explanation for this is calcium may have an important role as a catalyst in reaction between carbon and CO<sub>2</sub>. The hierarchical pores structure with tri – modal pores structure (micropore – mesopore – macropore) can be successfully prepared in this study. The hierarchical pores can be prepared by impregnation of RF gel with calcium nitrate together with CO<sub>2</sub> activation. The suitable activation temperature is 700 – 900 °C. The activation time and CO<sub>2</sub> flow rate are 30 min and 50 cm<sup>3</sup>/min, respectively.

The obtained hierarchical pores structure has high potential to be good candidate for applications such as HPLC column and catalyst support. Mesopore plays a role as an important for these applications. The macropore in the obtained hierarchical pores structure allows the fluid to flow through structure while mesopore – micropore do their functions at the same time.

### **5.3 Recommendation for future work**

The removal of metals on the interconnected macroporous structure is interesting topic for future study. In case of sodium and potassium impregnation, the porosity may be developed in activation process but the pore may be blocked by crystals occurred after activation. In addition, in some applications such as HPLC column, the hierarchical pores structure must not be contaminated by any metals. Furthermore, TEM measurement may be required for mesoporous character analysis.