CHAPTER VIII
CONCLUSIONS AND RECOMMENDATIONS

Conductive polymer nanoparticles, including polyaniline (PANI) and polypyrrole (PPY), with different morphologies and narrow size distribution were successfully synthesized by oxidative polymerization of such monomers in the presence of different types of template. PANI nanofibrils and dendritic PANI nanoparticles were obtained by using chlorophyllin and carboxymethyl chitin (CM-chitin) as templates, respectively. Contrary, the larger size with irregularly shape PANI aggregated was observed by the synthesis without the addition of templates. Additionally, by controlling concentration and degree of cross-linking of CM-chitin template, the distinct morphologies and different in size of PANI nanoparticles were achieved. CM-chitin, moreover, was explored to use as the template for synthesizing the spherical polypyrrole with narrow size distribution as well. Molecular characterizations suggest that the addition of template causes the change in morphology only but it dose not influence the molecular structure of the synthesized products. To find some merits of the synthesized nanoparticles over than their macroscopic counterparts, the dispersion and rheological behaviours of both nanoparticles and macroparticles suspended in other polymer solutions were investigated. SEM images indicate the better dispersion of PPY nanoparticles in the CM-chitin matrix while the extensive aggregation or partially phase separation were observed, at same blend composition, in its macroparticle blends. Interestingly, it was further found that the addition of PPY nanoparticles can significant reduce the viscosity of alginate. On the other hand, the viscosity of alginate increases when adding the PPY macroparticles. The reduction of viscosity provides some advantages in the production of composite materials, for example, improving processability and productivity.

Although the conductive polymer nanoparticles usually result in superior properties than their macroparticles, as mentioned above, but the aggregation of the obtained nanoparticles is still a major problem. If the nanoparticles are extensive aggregate, they will lose their own properties and behave like macroparticles.

Therefore, the finding of some techniques that can produce the nanoparticles without the aggregation of such particles remains a challenge.

In this dissertation, authors explored that some materials, such as chlorophyllin and CM-chitin, can be used as the templates for synthesizing the polyaniline nanoparticles. However, the aggregated particles, especially in case of dendritic PANI nanoparticles, were also observed. To eliminate or prevent this problem, future works are recommended, as follows: 1) polymerization of monomers in a very dilute condition to hamper an aggregation of particles, 2) use of the sonication instead of the mechanical stirring to prevent an aggregation of particles, or 3) adding some specific surfactants to help dispersion of those particles.

After finding the techniques to prevent the aggregation of particles, it is very interesting to fabricate and characterize the nanocomposite materials from the obtained nanoparticles. Finally, the prepared nanocomposite should be further studied for some potential applications such as biosensors, actuators, and drug controlled release, in comparison to the composite prepared from macroparticles.