CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Flexible compliant electrode has been prepared by natural rubber (NR) filled with multilayer graphene nanoplatelets. The crosslinked NR films were obtained by UV crosslink technique.

For the effects of UV-irradiation time and crosslinker concentration on the mechanical property of pure NR, it was found that the mechanical performance was improved with increasing UV-irradiation time and crosslinker concentration due to more crosslinking density of the NR. But the mechanical properties dropped off with over crosslinking condition as UV-irradiation time was more than 10 minute and crosslinker concentration was more than 5 %v/v. Furthermore, the best crosslinking condition was 7 minute of UV irradiation time and 5.0 %v/v crosslinker concentration that exhibited the yield strength of 0.77 MPa, yield strain of 50.4 %, and modulus of 0.018 MPa with the crosslink density of 7.3×10^{-5} mole/cm^3.

In addition, the mechanical property of NR was improved when adding of graphene. The strength of NR film was increased from 0.6 MPa to 9.9 MPa with adding 20 %v/v of graphene which is more than 1500% increase in the strength. Comparing with DANFOSS commercial compliant electrode, over 5.0 %v/v of graphene embedded in NR matrix exhibited a better mechanical performance. Especially for yield strength, these composites showed a value higher than that of DANFOSS by a afctor of 2.

For electrical conductivity of the composite films, the highest electrical conductivity was obtained from the 35.0 %v/v graphene/NR composite (0.6 S/cm) and it was improved by 4 orders of magnitude when compared with the pristine rubber. Moreover, the electrical performance of the composite did not significantly change within 20 times of stretching cycle due to the uniform dispersion of graphene in NR matrix.

From these results, it can concluded that the 5.0 %v/v graphene/NR composite is a potentially good material for being used as a compliant electrode with good mechanical properties, high electrical conductivity, and very low conductivity drop under repeating stretching cycle.

5.2 Recommendations

When increasing graphene concentration over 10 %v/v, the graphene nanoparticle will agglomerate within composite film that causes the mechanical properties to drop. To solve the problem, the optimum concentration of surfactant and NR latex could be redefined, calculated, and used. Moreover, the graphene concentration beyond 30 %v/v may cause breakdown of the film during stretching.