Effect of Morphology of MWCNT on Stability Enhancement of Nanofluids by using PVA Surfactant

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Abstract: Nanofluids are prepared by dispersing MWCNT into Polyvinyl Alcohol suspensions which distilled water used as base fluid. This paper summarizes the recent progress on the study of nanofluids which is investigates the effectiveness of Polyvinyl Alcohol (PVA) as surfactant for CNT/water nanofluids. The stability of nanofluids is measured by Zeta Sizer Nano-ZS (Malvern Instruments, ZEN3600). The zeta potential of the stable samples was analyzed. The morphological study of structure of CNT and its interaction with PVA dispersant was analyzed using SEM (FEI Quanta 400F, USA). The experimental results show that the zeta potential of stable samples indicated that the nanofluids are stable. The results demonstrated that zeta potential effect by concentration of CNT, it was increased with an increase in CNT concentration. The SEM results showed that the amount of PVA added to each CNT concentration is sufficient to provide maximum stability to the CNT-water nanofluids, no excessive agglomerations or significant clusters of PVA can be observed from the surface of CNT. In summary, this work provides useful insight on the behavior of CNT nanofluids.

***Keywords*:** Carbon nanotubes, nanofluid, stability, morphology, Polyvinyl Alcohol

INTRODUCTION

Nanofluids have very small particles and pursuant to the Stokes theory, they will be more stable than common suspensions. The stability of the nanofluids using zeta potential process will be identified. By using the nanofluids that can overcome the problems of poor suspension stability and channel clogging of mil and micro particles and also will develop the overall properties and heat transfer characteristics of base fluid even then the development and applications of nanofluids may be limited by several factors owing to use of very small size solid particles with very small concentration (2). The zeta potential for stable samples of CNT (0.01, 0.02, 0.04, 0.08 and 0.1 wt.%) were tested, in order to further verify the extent of stability of the nanofluids. The morphological structure of the dried CNT nanoparticles coated with PVA dispersant can be examined using SEM to provide crucial insights of the adsorption of PVA onto the surface of CNT and the interactions between them.

MATERIALS AND METHODS

Distilled water, Polyvinyl Alcohol (PVA) and carbon nanotubes were used in this research to prepare nanofluids. The carbon nanotubes were provided by Lab. Scientific, Malaysia and Poly vinyl alcohol, $(C_2H_4O)_n$ was obtained from Sigma-Aldrich. A Zetasizer Nano-ZS (Malvern Instruments, ZEN3600) was used to analyse the zeta potential of the stable nanofluid samples. In order to investigate the stability of the nanofluids, approximately 2 mL of each nanofluid suspension was transferred into a cuvette and measured at 25 °C. A scanning electron microscope (SEM) (Model: Quanta 400F, USA) was utilised to analyse the morphological structure of the CNT/water nanofluid with PVA dispersant. A small sample of the stable nanofluids was transferred into a petri dish and dried overnight in an oven at 100 °C before it was observed under SEM.

RESULTS AND DISCUSSION

The zeta potential for stable samples of CNT (0.01, 0.02, 0.04, 0.08 and 0.1 wt.%) in Figure.1 shows that all the values are close to the stability dividing line of ±30 mV, so it indicated that the nanofluids are stable (1).

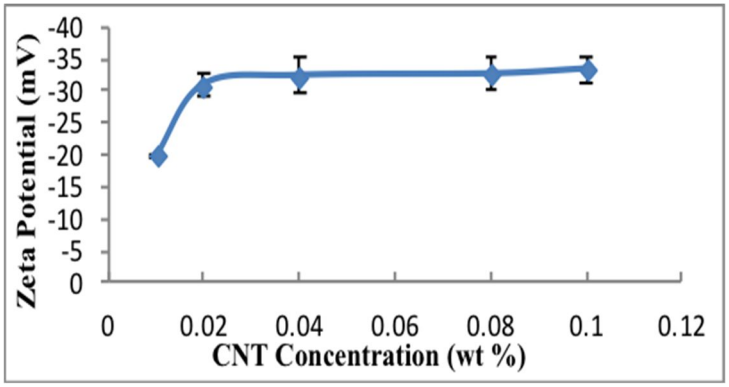

Fig.1. Zeta potential values of stable CNT-water nanofluids.

The results demonstrated that the Zeta potential of CNT suspension was enhanced with enhancing PVA concentrations. The morphology analysis using SEM exhibits since the amount of PVA added to each CNT concentration is sufficient to provide maximum stability to the CNT-water nanofluids, no excessive agglomerations or significant clusters of PVA can be observed from the surface of CNT (3).

CONCLUSIONS

The findings of this study prove that the high stability and low agglomeration rate of nanofluids can be obtained as a potential candidate for coolant in heat exchanging devices. The stability of nanofluids and the cost of producing them are major factors preventing the commercialization of nanofluids. By solving these challenges, it is expected that nanofluids can have a significant effect as a cooling device in heat exchangers. The detail investigations on the cumulants means of nanofluids should be performed in the future to understand the effect of nanofluid size on the stability of nanofluids.

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