FUNCTIONALIZING MULTI WALL CARBON NANOTUBES BY SUPER AND NEARCRITICAL WATERS

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Functionalizing multi wall carbon nanotubes(MWCNT) by oxygen and ammonia in super and nearcritical waters has been studied. Carbon nanotubes have non-polar surfaces and agglomerate together very easily. Although MWCNT has very powerful mechanical, thermal and electrical properties, these advantages can not be realized unless they are well dispersed to substrates. To enhance the compatibility with polar media, non-polar surfaces of MWCNT have to be changed. Furthermore, the functional groups of MWCNT's surfaces will be inevitable to encourage their applications. Most popular method for modifying MWCNT is acid treatment. However, since CNT particles agglomerate together and they are entangled seriously, it is very difficult to modify surfaces of CNT particles uniformly. Supercritical water(SCW) is miscible with gaseous oxygen and can penetrate to small micro-pores very well. These miscible and penetrating characteristics of SCW can support uniform partial oxidation of MWCNT particles. It was demonstrated in the previous studies[1,2] that the outer walls of MWCNT could be functionalized by SCW with diluted HNO_3 solution and oxygen gas.

In this study, MWCNT has been functionalized by oxygen gas and ammonium hydroxide solution in SCW to endow the functional groups such as carboxyl, hydroxyl, carbonyl, amide, amine, etc. To determine the effects of temperature, reaction time, type and amount of oxidants on the partial oxidation of MWCNT, the screening test of statistical design of experiments has been applied. These experiments were conducted by using a lab-scale continuous supercritical water oxidation apparatus.

The functional groups were characterized by FT-IR spectra as shown in Fig. 1. Partially oxidized carboxyl and hydroxyl groups could be found when only the oxygen gas was used as modifier. On the other hand, amine and amide groups were found also when the ammonium hydroxide solutions were added as a modifier as well as oxygen gas as shown in Fig.1.

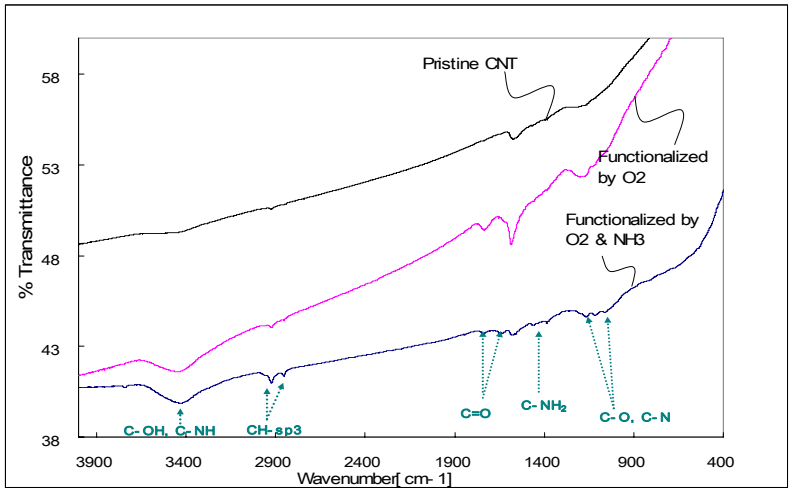

Fig.1. FT-IR spectra of pristine and modified MWCNT.

References

[1] K.C. Park, T. Hayashi, H. Tomiyasu, M. Endo, M.S. Dresselhaus, *J .Mater. Chem.* **2005**, 15, 407 – 411.

[2] J.H. Han, J.S. Lee, S.H. Do, S.C. Hong, *11th European Meeting on Supercritical Fluids, Barcelona, Spain,* **2008**.