

# PREPARATION OF NON-CRYSTALLINE CARBON FROM COMPOSITE RESIN AND ITS ANODIC CHARACTERISTICS FOR LIB

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## Introduction

Carbon is the fascinating material especially in energy storage field such as secondary battery, capacitor and gas storage, which is due to large degree of freedom in its form (fibrous to particulate) and structure (vitreous to graphitic). The degree of freedom results in the diversities in electrical /thermal property, mechanical property or pore structure etc., which may be due to the diversities in stacking of hexagonal basal planes. In Li ion secondary battery (LIB), high energy density and cyclic property through charge and discharge is required, as miniaturization of portable instruments such as mobile phone and notebook computer proceeds. Graphite which is wide-using anodic material and has 372mAh/g of theoretical discharge capacity, is unsatisfactory for this purpose. Therefore, various studies are proceeding to develop the anodic materials with high energy density and capacity, mainly in non-crystalline carbon system, carbon-metal system or metal-alloy system etc. Non-crystalline carbon is considered to be most applicable to LIB with high capacity among them.

We considered non-crystalline carbon could be prepared to have unexpected properties through chemical interaction of two inherently different resin (thermosetting/thermoplastic), as shown in Fig. 1.

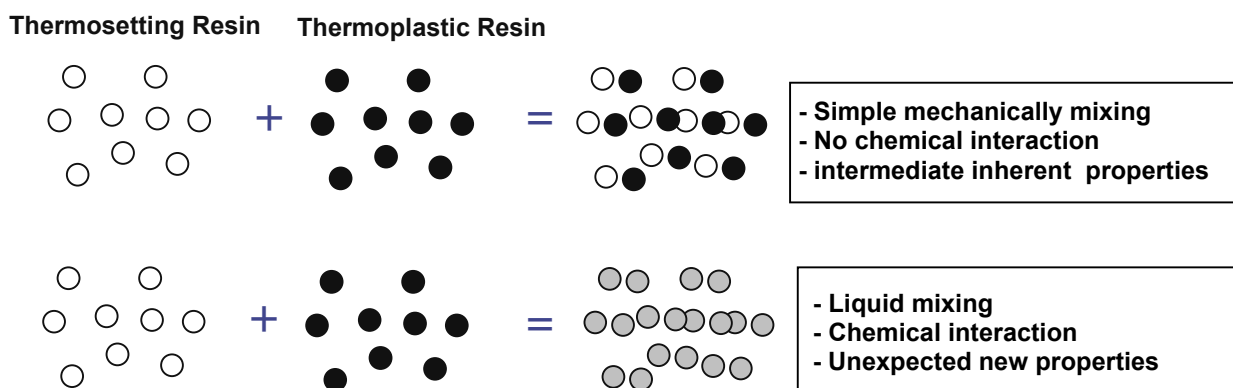


Figure 1. Schematic illustration for non-crystalline carbon from composite resin

## Experimental

Coal tar-based pitch (sp=100°C) of thermoplastic resin and phenolic resin of thermosetting resin, were used as carbon precursors, which had similar carbon yield (50%) after thermal treatment at 1000°C. Each resin was homogeneously stirred with solvent up to 8000rpm at 150°C to have suitable thermoplastic resin/ (thermosetting

resin) ratio. Composite resins were stabilized and thermally treated at 600-1000 °C under nitrogen atmosphere. Non-crystalline carbons after thermal treatment were pulverized to suitable size, and characterized by microstructure(HR-SEM & XRD), specific surface area(BET plot) and charge/discharge capacity(coin cell type).

### Results and Discussion

Figure 2<sup>1)</sup> shows the change in SSA(specific surface area) as functions of thermosetting resin contents and thermal treatment temperature. SSA was increased with increase of thermosetting resin contents, and was decreased with increase of thermal treatment temperature. Figure 3 shows the dependence of discharge capacity on thermosetting resin contents and thermal treatment temperature. Discharge capacity was maximized at the vicinity of 20% of thermosetting resin contents and at 700 °C of thermal treatment temperature. Discharge capacity of the carbon material at optimum condition was superior to those at each end member(neat thermoplastic or thermosetting resin-derived carbon)

The phenomena means liquid mixing with high rpm could induce the chemical interaction between two inherently different resins.

The effect of carbon nano-fiber addition on cyclic property of non-crystalline carbon was also investigated to improve electrical conductivity.

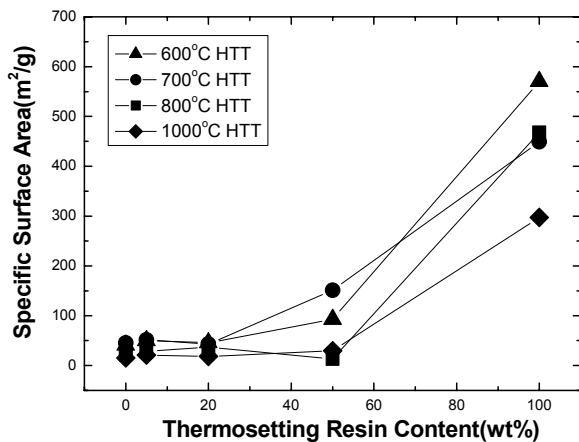


Figure 2. Specific surface area change

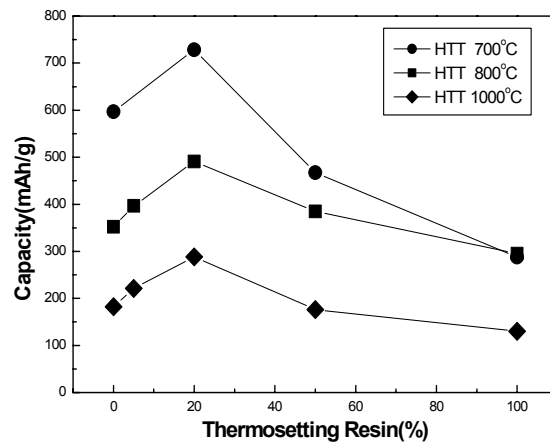


Figure 3. Discharge capacity

### Conclusions

It was possible to prepare non-crystalline carbon materials from composite resin (thermoplastic/thermosetting) for application of LIB system. As a result, optimum conditions existed to have maximum discharge capacity. The phenomena are suggestive of chemical interaction between two inherently different resins.

### References

[1] S. Park, Y. Lee, S. Oh, K. Kang, Extended abstract of the 30th annual conference of the Carbon Society of Japan, 2003: 286-287.