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Surface Hydrophobicity of Polyethylene by Cationic Polymerization of Octamethylcylotetrasiloxane using Supercritical Carbon Dioxide

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Introduction

A synthetic method for producing a new polymer composite using supercritical carbon dioxide ($scCO_2$) has been developed[1]. We have already succeeded in obtaining micro-phase separated polymer composite of isotactic polypropylene (iPP) or syndiotactic polystyrene (sPS) with poly(methyl methacrylate) (PMMA), even though these polymers are incompatible with each other and the polymer blend. PMMA is blended with the amorphous region in a crystalline polymer (iPP or sPS) at a molecular level[2].

The surface of Polydimethylsiloxane (PDMS) is very hydrophobic. We prepared polyethylene (PE)/PDMS composite using $scCO_2$ to obtain PE with the high hydrophobic surface.

Experimental

The PE substrate, octamethylcylotetrasiloxane (D4) (5g), hexamethyldisiloxane (0.006g) and sulfuric acid (0.013mL) were placed in a 50mL stainless steel vessel and sealed. After the system reached to thermal equilibrium (35°C), the vessel was pressurized to 6.0 MPa by a CO_2 delivery pump and soaked for 1 h. The PE/PDMS polymer composite was dried in vacuo at room temperature after extraction with chloroform for 24 h to remove unreacted reagents and PDMS generated on the surface of the PE/PDMS polymer composite by using a Soxhlet extractor. The weight of PDMS which generated in PE ground substance displayed it as weight increase rate (wt%) for the weight (100) of the ground substance sheet.

Results and Discussion

Fig.1 shows XPS charts of PE, PDMS, and PE/PDMS polymer composites. In the case of PE, a strong peak is observed. In PDMS, three strong peaks are observed. In PE/PDMS polymer composite, except for the carbon peak of PE, the strength of oxygen and silicon peaks increases. It can be concluded PDMS was generated in the surface of PE.

Fig.2 shows the static contact angle of all the specimens. The value of the PE/PDMS polymer composite is larger than that of PE, and almost constant with changing the mass gain of PDMS. This is because only the PDMS that is at a depth of 0.2–3nm affects the hydrophobicity[3]. These results imply that the hydrophobicity of PE has been improved.

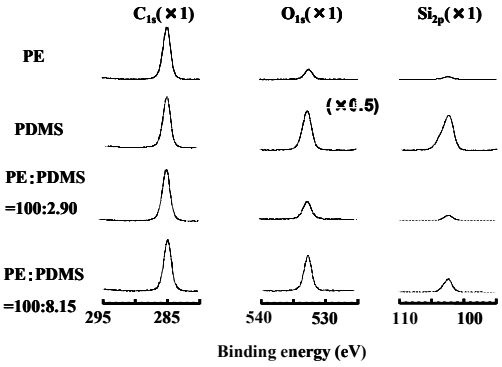

Fig. 1 XPS charts of PE, PDMS, and PE/PDMS polymer composites. (Take-off angle is 90°)

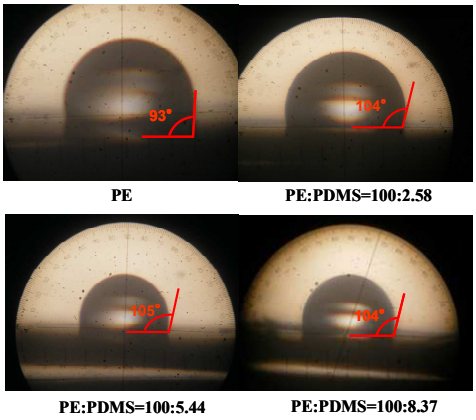

Fig. 2 Pictures of static contact angle measurements of the surface of PE and PE/PDMS polymer composites.

We have succeeded in obtaining PE/PDMS polymer composite using $scCO_2$ to obtain PE with the high hydrophobic surface.

References

1) T. Hoshi et al. *Polymer*, **48**, 1573-1580, 2007.
2) T. Sawaguchi et al. *Kobunshi Ronbunnshu*, **62**, 251-260, 2005.
3) K. Ishihara et al. *Biomateriaru*, Corona Publishing Co., Ltd., Japan, 1999 (chapter 4).

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