題目(和文)	
Title(English)	Novel Thermoplastic Elastomers by Reactive Blending of Thermoplastic and Rubber
著者(和文)	JANTANASAKULWONGK
Author(English)	KITTISAK yuingying
出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第9280号, 授与年月日:2013年9月25日, 学位の種別:課程博士, 審査員:扇澤　敏明,鞠谷　雄士,塩谷　正俊,淺井　茂雄,松本　英俊
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第9280号, Conferred date:2013/9/25, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	Organic and Polymeric Materials 専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of (Engineering)
学籍番号： Student ID Number	[redacted]	指導教員（主）： Academic Advisor(main)	Prof. Toshiaki Ougizawa
学生氏名： Student's Name	Kittisak Jantanasakulwong	指導教員（副）： Academic Advisor(sub)	

要旨（英文800語程度）
Thesis Summary (approx.800 English Words)

In this study, novel thermoplastic elastomers (TPEs) were developed by polymer melt-blending of a thermoplastic and a rubber. The biodegradable plastics and polyamide were selected for the preparation of TPEs by melt-mixing process. To improve the mechanical properties and compatibility of the blends, the improvement of morphology and interfacial adhesion by reactive blending was examined.

Chapter one provides an overview of TPEs and the motivation for the development of TPEs made by a thermoplastic and a rubber blends.

In chapter two, Poly(butylene succinate) (PBS) was melt blended with maleic anhydride grafted ethylene-propylene-diene terpolymer (EPDM-MAH) and maleic anhydride grafted ethylene-1-butene copolymer (EB-MAH) to obtain TPEs containing a biodegradable polyester. The PBS/EB-MAH blend showed lower modulus and excellent strain recovery compared to the PBS/EPDM-MAH blend due to the smaller rubber particle size. Tensile strength of the PBS/EPDM-MAH blend was found to be significantly improved by annealing because of the increased interfacial reaction between PBS matrix phase and EPDM dispersed phase, and the increased cross-linking in EPDM. As the result, it was found that the annealing process is effective for improvement of the mechanical properties of the PBS/MAH grafted rubber blends.

In chapter three, PBS and acrylic rubber (ACM) were blended with dicumyl peroxide (DCP) or poly[methylene (phenylene isocyanate)] (PMPI). Phase determination test was used to observed phase morphology of the blends. These blends were immiscible, and rubber particles dispersed in PBS matrix. The tensile strength and elongation at break were improved by addition of DCP better than that by PMPI. Compatibility of PBS and ACM was highly improved by DCP, and smaller rubber particles were observed by SEM. These were suggested to the increase of interfacial reaction. The blend with PMPI showed bigger dispersed particles and ununiform dispersion, which was indicated that viscosity difference between PBS and ACM became larger by the reaction between ACM and PMPI.

In chapter four, new thermoplastic vulcanizate (TPV) was developed by melt-blending of poly(lactic acid) (PLA), ACM and EMAA-Na. The PLA/ACM/EMAA-Na blend showed low yield strength, low modulus and excellent strain recovery. SEM and TEM images confirmed that the morphology of PLA/ACM blend was co-continuous morphology, and presented same morphology in the PLA/ACM/EMAA and PLA/ACM/EMAA-Na, while EMAA-Na was detected inside ACM phase. The PLA/ACM/EMAA-Na blend showed the increasing of the complex viscosity and the decreasing of melting temperature due to the improvement of interfacial reaction. FTIR results indicated that PLA does not react with ACM, while EMAA-Na can interact with both PLA and ACM, and the Na^+ ion acts as catalyst for the interfacial reaction between PLA and ACM. Maximum tensile strength and elastic recovery of PLA/ACM/EMAA-Na blend were improved by addition of hexamethylene diamine carbamate (HMDC) due to the increasing of crosslink inside the rubber phase. TEM images confirmed that phase inversion occurred from co-continuous morphology to the dispersed ACM domain in PLA matrix when HMDC cross-linking agent was added into PLA/ACM/EMAA-Na blend, and EMAA-Na still remained inside ACM phase. The EMAA-Na around interface of rubber particles was suggested to form interaction to each other, and then the network of rubber particles was formed, and it acted as the matrix. It was indicated that, the interfacial reaction between PLA and ACM, the crosslinking of ACM phase and the interaction between rubber particles were suggested to improve the mechanical properties of the blend.

In chapter five, reactive blending of polyamide-6 (PA6) with maleic anhydride grafted ethylene-1-butene copolymer (EB-*g*-MAH) was performed to obtain heat and oil resistant thermoplastic elastomer (TPE). To improve the mechanical property of the blend, ethylene-methacrylic acid ionomer partially neutralized by sodium ion (EMAA-Na) was added to the blend, and the effect of addition of the EMAA-Na was investigated. Strain at break of the PA6/EB-*g*-MAH (40/60) was clearly higher than that of the PA6/EB (40/60). Addition of EMAA-Na (2 %) to the PA6/EB-*g*-MAH (38/60) blend induced increase of tensile modulus. TEM images confirmed that PA6 was matrix phase in the PA6/EB-*g*-MAH blend, while EB rubber phase was matrix in the PA6/EB blend. It was considered that the reaction between amino end group of PA6 and maleic anhydride in EB-*g*-MAH induced the significant change of blend morphology. The PA6/EB-*g*-MAH/EMAA-Na blend also showed similar morphology with the PA6/EB-*g*-MAH blend, and EMAA-Na was expected to locate inside of EB-*g*-MAH phase. From the results of rheological property, adhesive energy and FTIR measurements, it was found that ionic aggregates by neutralization of EB-*g*-MAH by sodium ion occurred by addition of EMAA-Na, and the change of the mechanical property by addition of EMAA-Na was brought by the ionic aggregate formation which acts as physical crosslinking in EB-*g*-MAH dispersed phase in the blend.

Chapter six is the general conclusions of this investigation and also provides suggestion for further investigations particularly in the area of TPEs and polymer blend. From the results obtained in this study, we suggest that the new types of TPEs are useful for industrial use in the future.