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생체접착제로 적용하기 위한 수분산 폴리우레탄의 특성 향상

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Abstract

본 연구에서는 폴리올로써 polycaprolactone diol, 이소시아네이트로 4,4'-methylene dicyclohexyl diisocyanate를 사용하여 수분산 폴리우레탄(WPU)을 합성하였다. 기존의 WPU는 기계적 물성 및 표면 특성이 미흡하고, 건조속도, 내수성 등이 저하되는 단점이 있어, 이를 보완하고 생체접착제로의 특성을 개선하고자 3개의 하이드록시기를 가지는 castor oil을 이용하여 가교된 WPU를 성공적으로 합성하였다. Polycaprolactone diol, castor oil과 4,4`-methylene dicyclohexyl diisocyanate를 pre-polymer로, dimethylol butanoic acid를 내부 유화제로, trimethylamine을 중화제로 사용하여 다른 분자량을 가지도록 각각 디자인하였다. Fourier-transform infrared spectroscopy(FT-IR), universal testing machine(UTM), contact angle, field emission-scanning electron microscopy(FE-SEM), degrading-enzyme systems 등을 평가 분석하여 분자량에 따른 기계적인 물성 변화, 표면개질 변화, adhesion 및 biodegradation 특성에 관한 연구를 진행하였다.

Objective

- **To synthesize the biocompatible waterborne polyurethanes (B-WPUs) through two-step processing**
- **To evaluate the castor oil effect on the mechanical properties of B-WPUs**
- **To investigate adhesion properties and the enzymatic biodegradability on the surface of aminated substrate**

Experimental

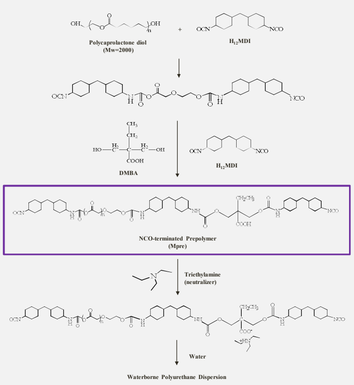
Formulation

(unit:mol)

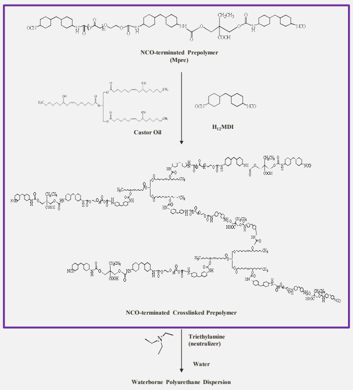
	Mpre	Series	Soft segment			Ionic group		Castor Oil		TEA
			PCL530	PCL2000	$H_{12}MDI$	DMBA	$H_{12}MDI$	Castor Oil	$H_{12}MDI$	
H1	3000	3-530	0.0293	-	0.0296	0.0101	0.0203	-	-	0.0101
H2		3-2000	-	0.0103	0.0104	0.0101	0.0203	-	-	0.0101
H3		3-530-C	0.0293	-	0.0296	0.0101	0.0203	0.01	0.01	0.0101
H4		3-2000-C	-	0.0103	0.0104	0.0101	0.0203	0.01	0.01	0.0101
H5	6000	6-530	0.0310	-	0.0313	0.0101	0.0153	-	-	0.0101
H6		6-2000	-	0.0108	0.0110	0.0101	0.0153	-	-	0.0101
H7		6-530C	0.0310	-	0.0313	0.0101	0.0153	0.005	0.005	0.0101
H8		6-2000C	-	0.0108	0.0110	0.0101	0.0153	0.005	0.005	0.0101

Solid:30g, Ionic group:5wt%

Scheme 1

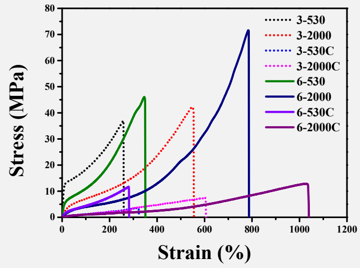


Scheme 2



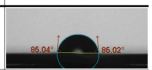
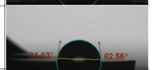
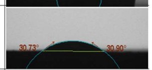
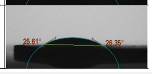
Results

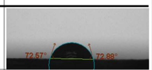
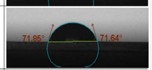
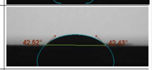
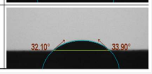
Mechanical property of WPUs



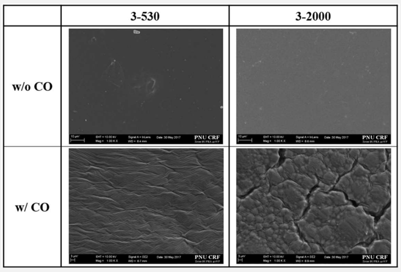
	PU Code	Young's Modulus (MPa)	Stress at break (MPa)	Elongation at break (%)
H1	3-530	194.91	36.77	255.69
H2	3-2000	23.24	41.81	551.11
H3	3-530-C	0.80	3.54	319.86
H4	3-2000-C	1.38	2.02	124.86
H5	6-530	75.67	46.02	346.94
H6	6-2000	8.16	15.51	529.44
H7	6-530-C	5.79	11.53	278.61
H8	6-2000-C	0.72	12.58	1034.86

Contact Angle Test of WPUs

	Series	Mean(°)	
H1	3-530	85.02	
H2	3-2000	82.20	
H3	3-530-C	30.82	
H4	3-2000-C	25.98	

	Series	Mean(°)	
H5	6-530	72.73	
H6	6-2000	71.75	
H7	6-530-C	42.48	
H8	6-2000-C	33	

FE-SEM image of WPUs



Conclusion

- **A molecular weight series of Castor oil-based B-WPU were successfully controlled**
- **Mechanical properties can be adjusted to suit particular wound closure**

Acknowledgement

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