

The effect of biodegradable waterborne Polyurethane on high performance bio-adhesive

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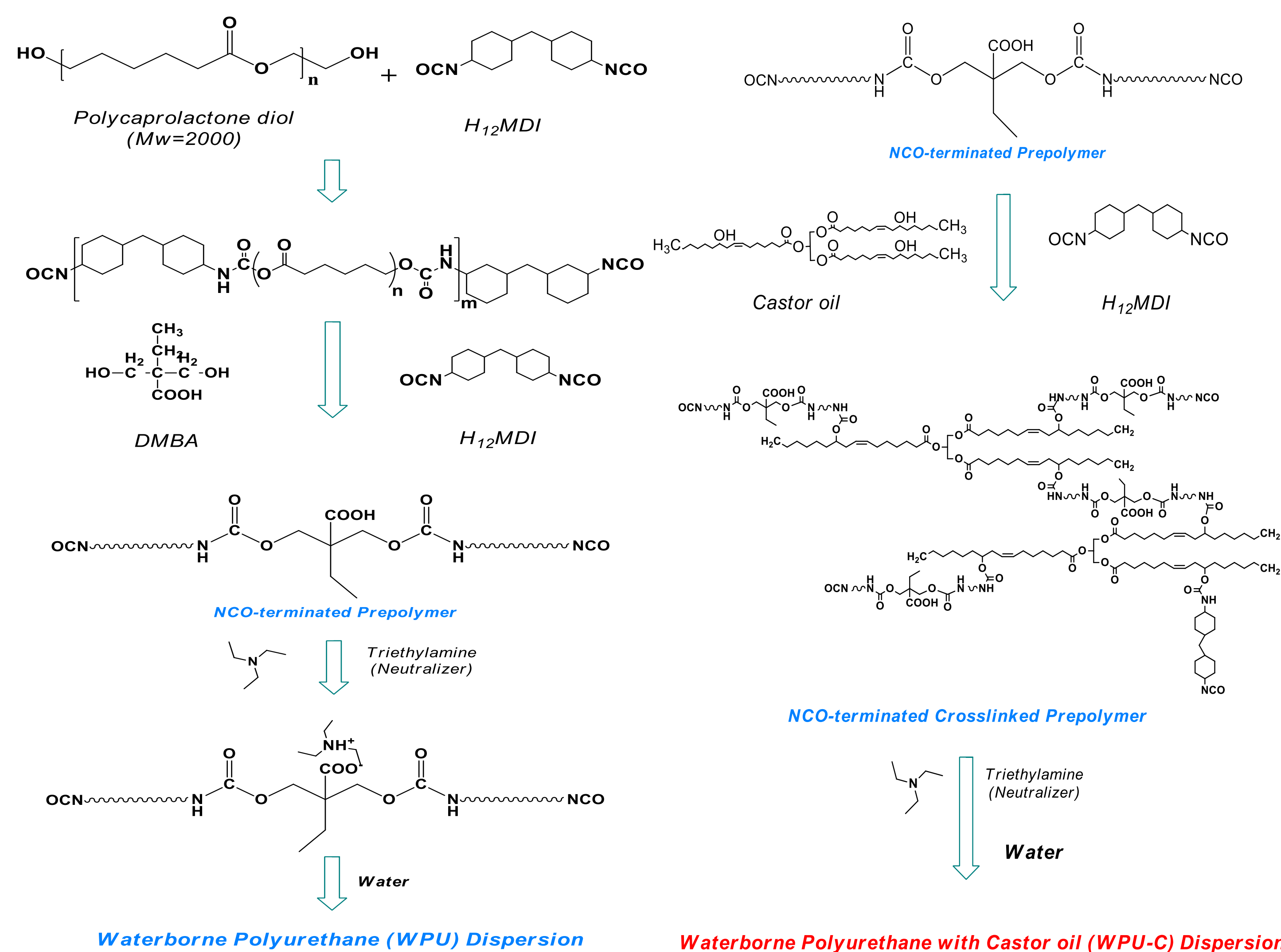
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Abstract

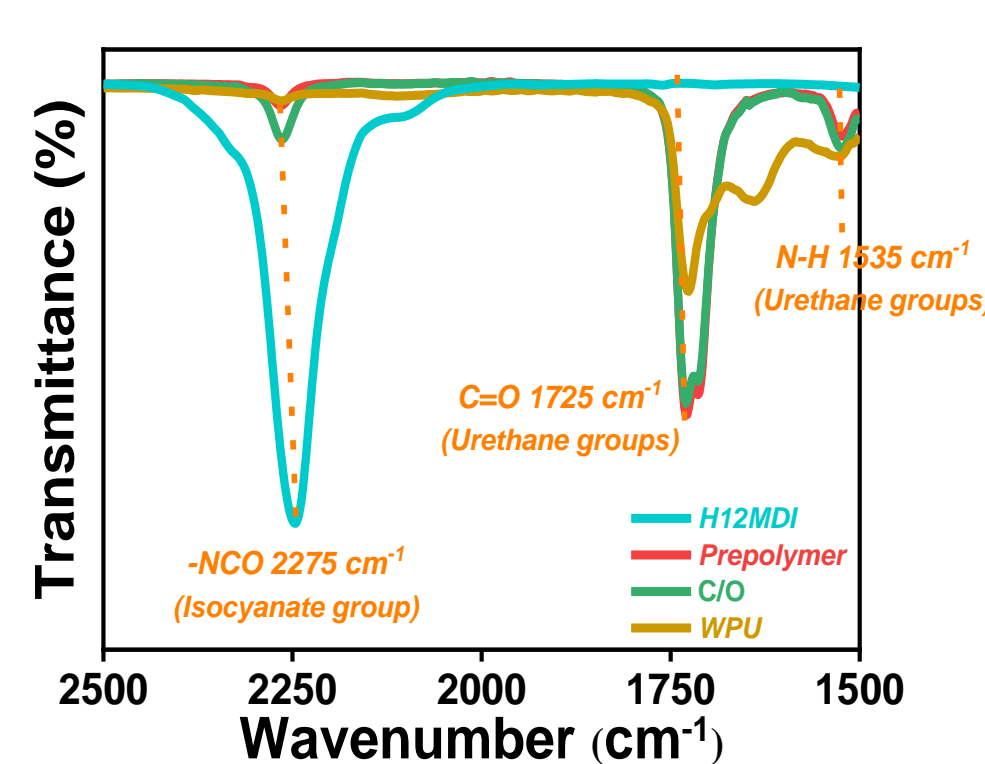
A series of waterborne polyurethane (WPU) polymers was synthesized using polycaprolactone diol (PCL) and 4,4'-methylene dicyclohexyl diisocyanate (H12MDI) as the main domains of urethane, dimethylol butanoic acid (DMBA) as the anionic internal emulsifier and trimethylamine as the neutralizing agent. Castor oil was also added to confirm the change in the physical properties of WPU according to the presence and molecular weight of castor oil and maximize the biodegradability and biocompatibility of the WPU series made in this way. WPU was designed to increase bio-adhesion because castor oil increases the total molecular weight of the WPU, which increases the crosslinked structure. As a result, mechanical properties were improved, and biodegradability evaluation using bio-enzymes was also conducted. The biodegradability evaluation using the effect of the bio-enzymes was thoroughly analyzed through field emission scanning electron microscopy (FE-SEM). WPU made through the above experiment has excellent physical properties and is biodegradable by bio-enzymes. Therefore, it is environmentally friendly and can be a promising candidate in various biofields.

Experimental

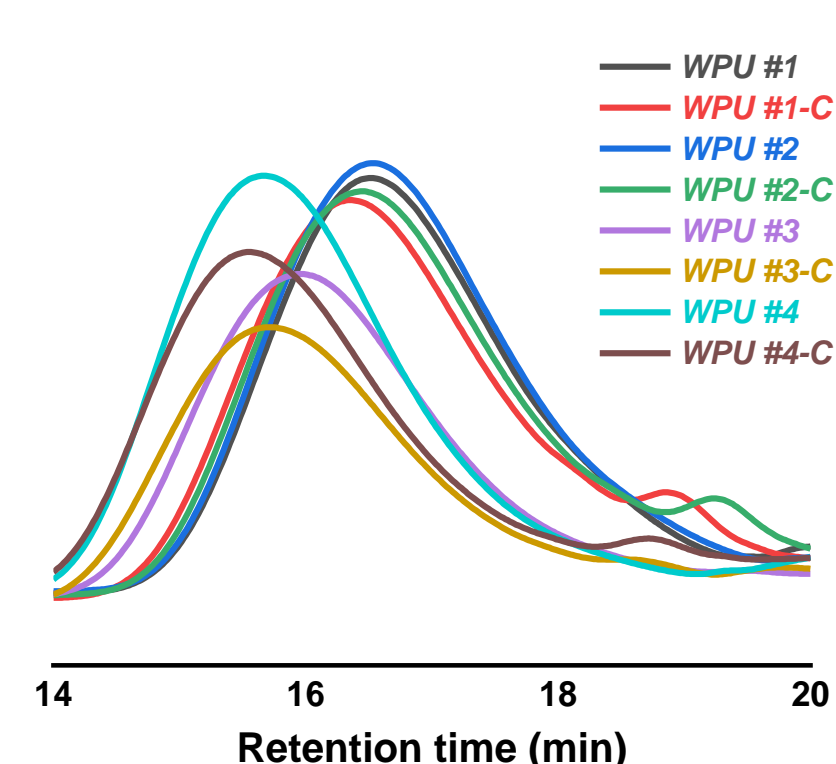


Results

FT-IR

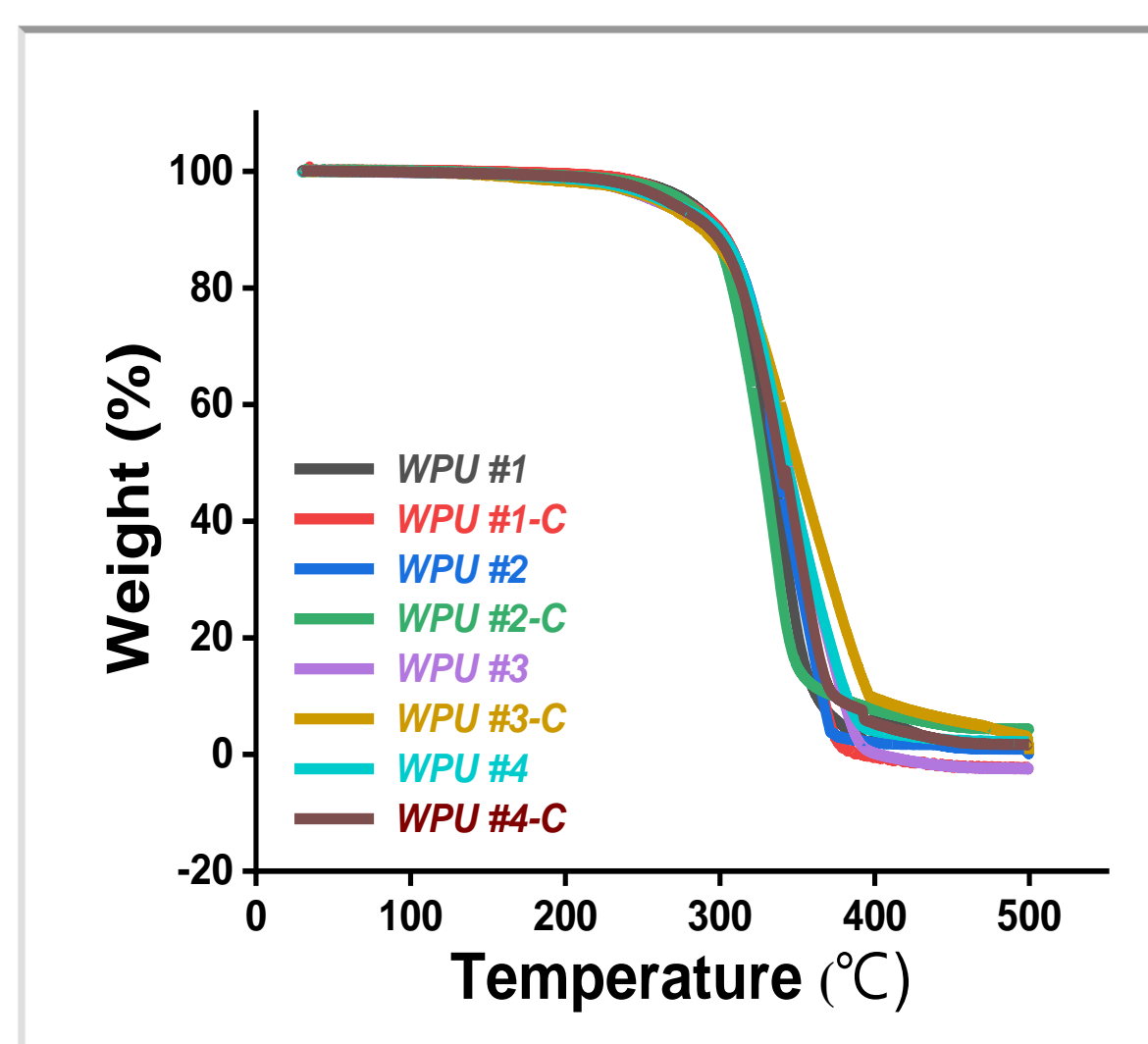


GPC

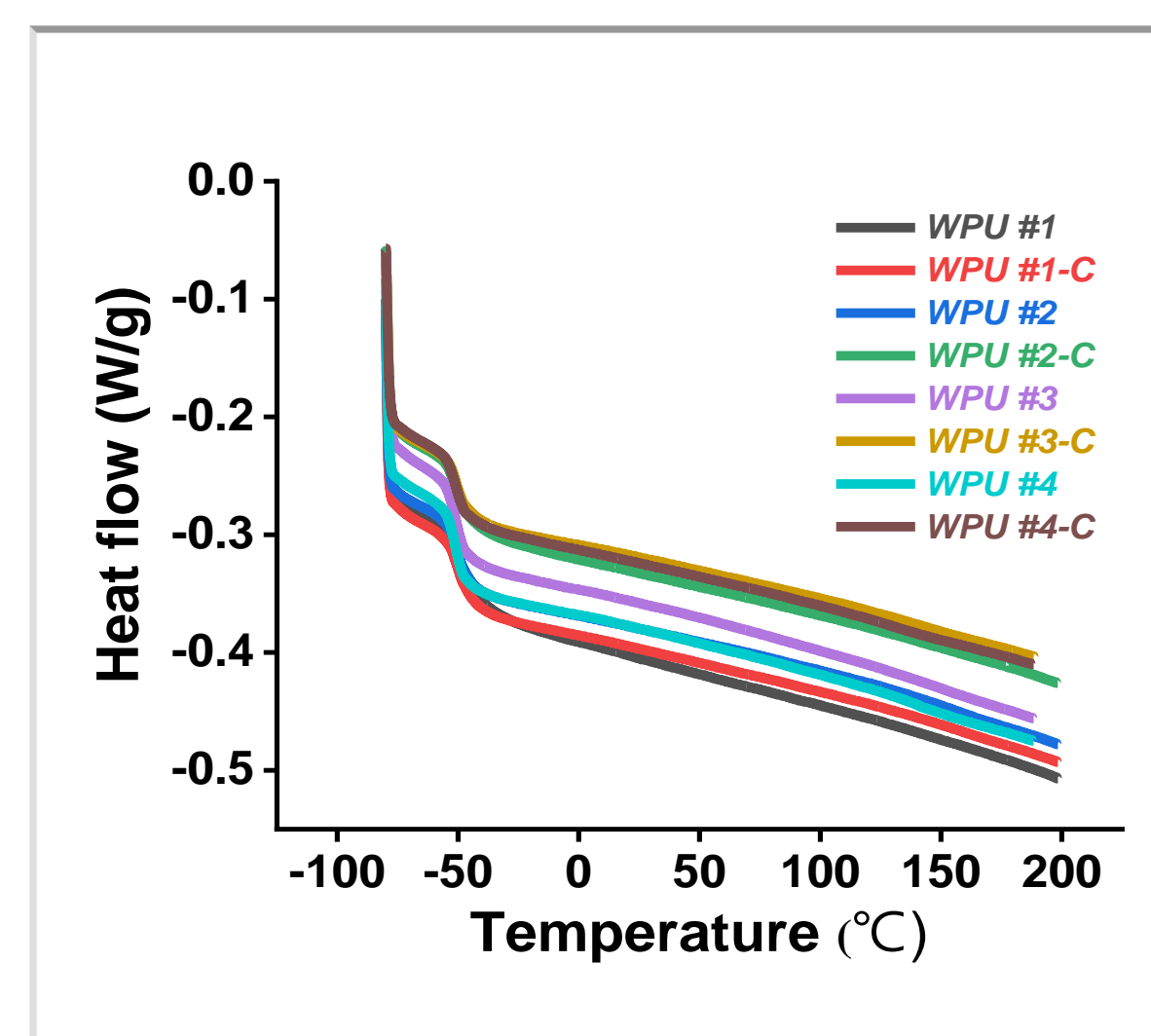


| Series | M _n | M _w | PDI | Particle size (nm) |
|----------|----------------|----------------|------|--------------------|
| WPU #1 | 8754 | 16621 | 1.89 | 138.87 |
| WPU #1-C | 10765 | 18821 | 1.74 | 180.58 |
| WPU #2 | 9863 | 17591 | 1.78 | 185.89 |
| WPU #2-C | 11850 | 20064 | 1.69 | 195.20 |
| WPU #3 | 16291 | 28361 | 1.74 | 188.83 |
| WPU #3-C | 18622 | 31161 | 1.67 | 208.60 |
| WPU #4 | 21302 | 36596 | 1.72 | 219.09 |
| WPU #4-C | 23254 | 39987 | 1.72 | 229.80 |

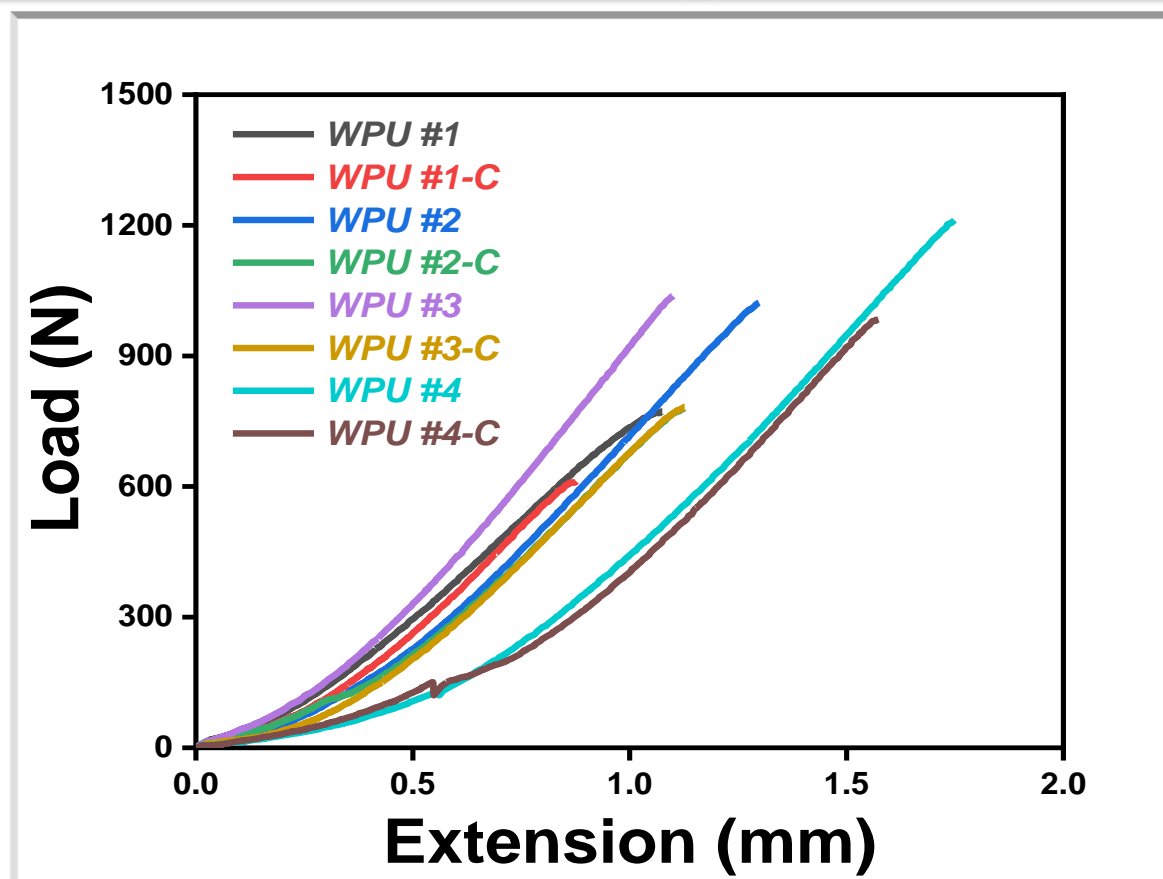
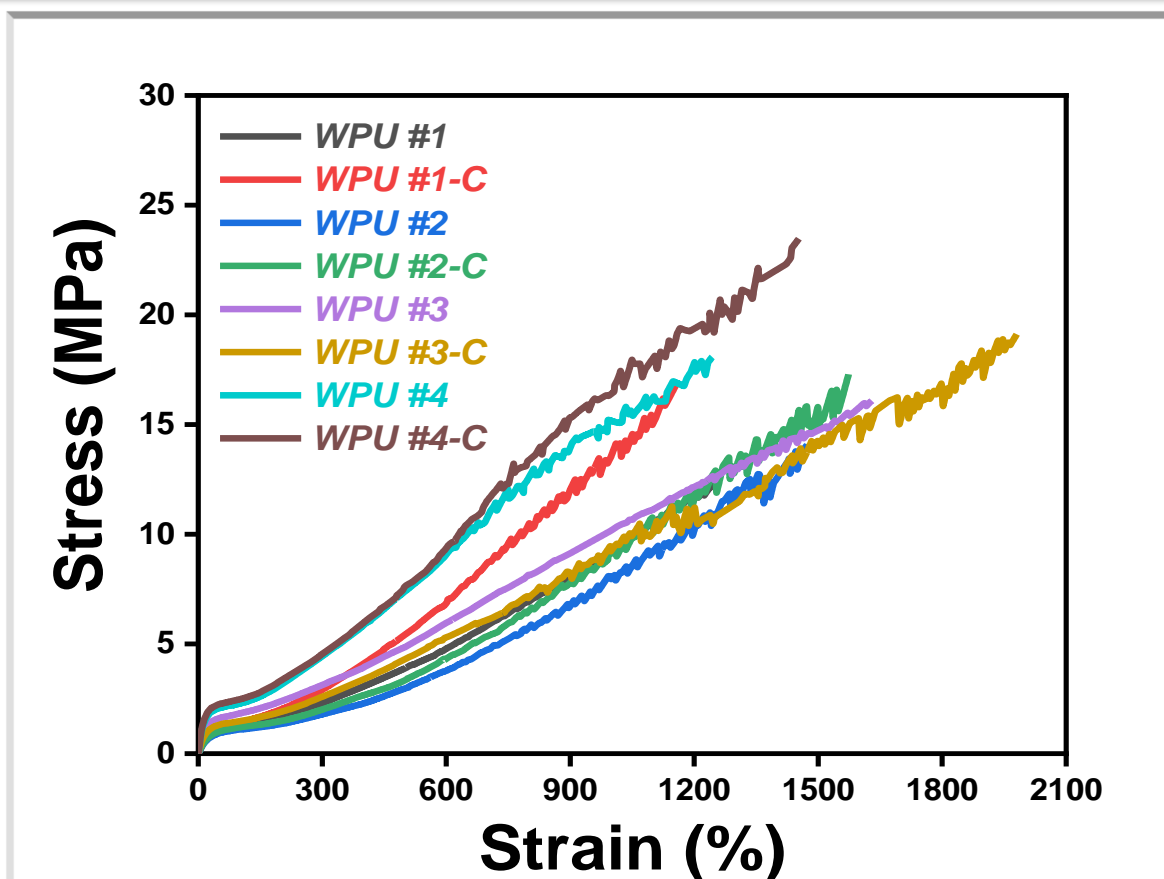
TGA



DSC

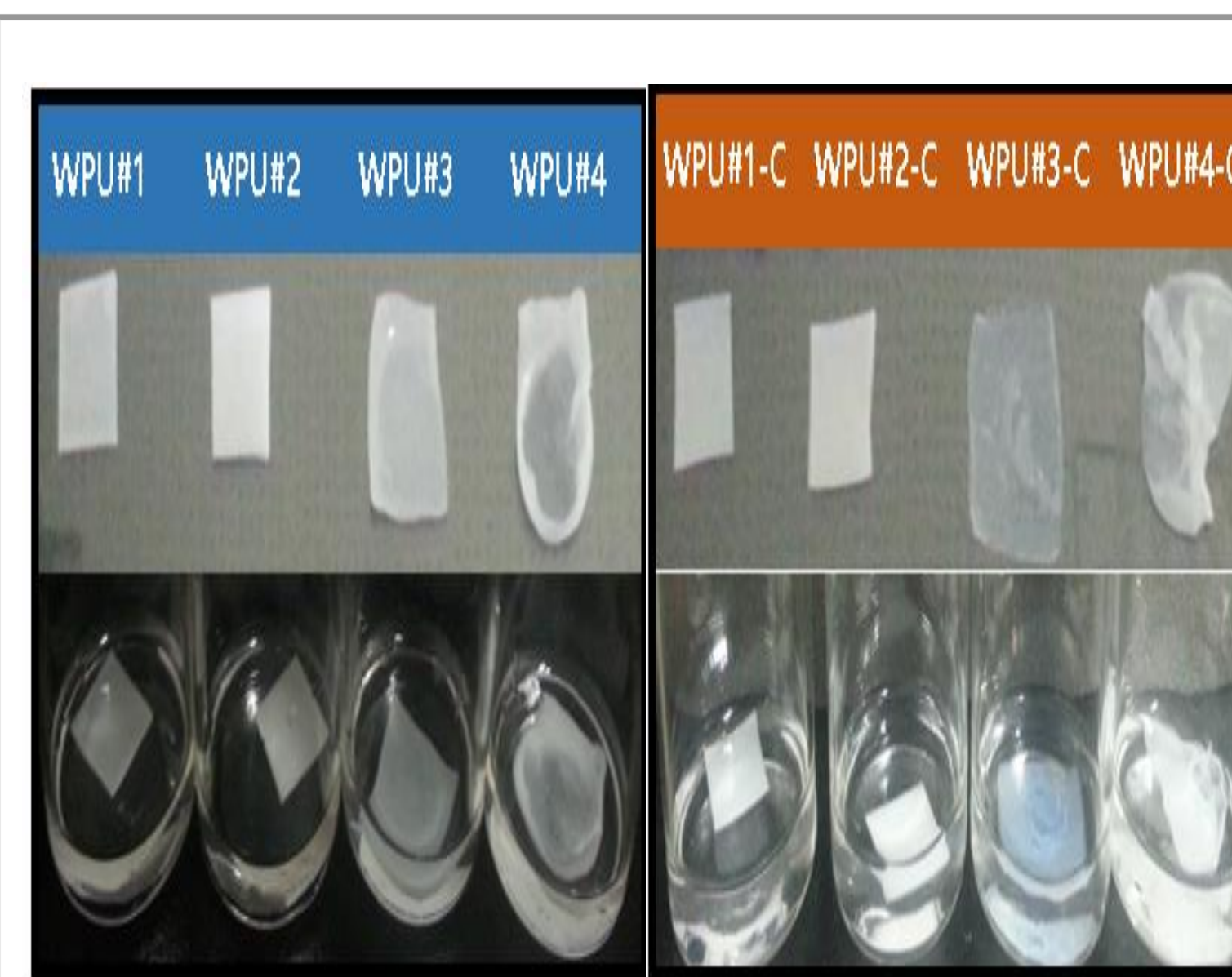


UTM

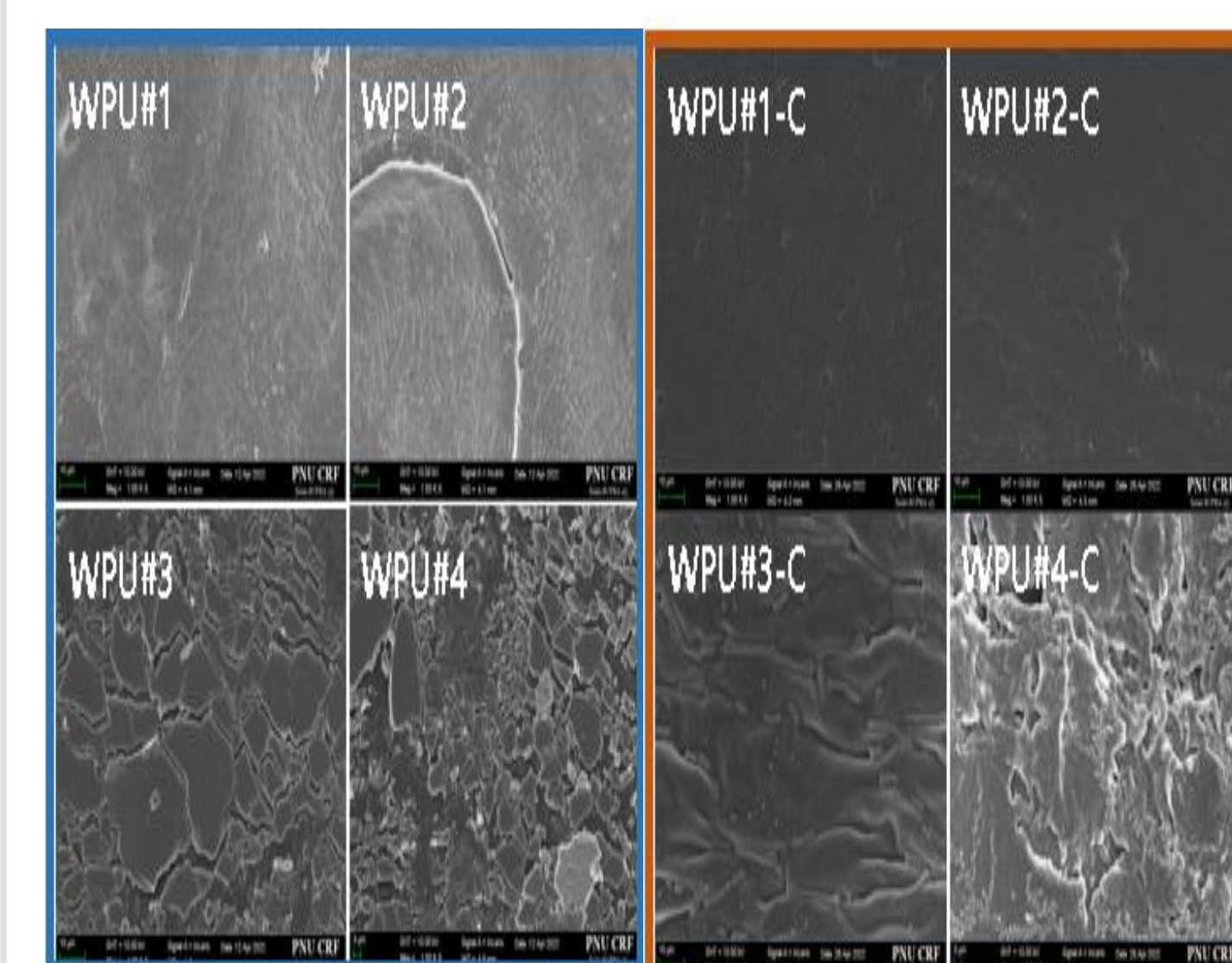


| Series | Tensile Stress (MPa) | Strain (%) | Load (N) |
|----------|----------------------|------------|----------|
| WPU #1 | 12.28 | 1247.3 | 773.11 |
| WPU #1-C | 16.85 | 1157.1 | 611.73 |
| WPU #2 | 14.10 | 1474.3 | 1022.5 |
| WPU #2-C | 17.29 | 1573.5 | 778.92 |
| WPU #3 | 16.09 | 1629.8 | 1037.2 |
| WPU #3-C | 19.12 | 1980.5 | 783.28 |
| WPU #4 | 18.08 | 1243.4 | 1212 |
| WPU #4-C | 23.47 | 1453.1 | 983.75 |

Enzymatic degradation



FE-SEM



Conclusion

- Synthetic recipes according to the presence or absence of castor-oil in the PCL-based waterborne urethane series showed their potential as a bio-adhesive.
- As a result of biodegradation evaluation using bio-enzymes, castor oil affects biodegradability, showing the possibility of using biodegradable urethane in the future.

Acknowledgement

This work was supported by the Technology Innovation Program (20014436, Development of biodegradable polycarbonate material and mass production process technology) funded By the Ministry of Trade, Industry & Energy(MOTIE, Korea)