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# Direct Observation of Microphase-separated Structure of Polyurethane by Temperature Dependent Atomic Force Microscopy

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## Introduction

A microphase-separated structure formed in polymers plays a quite important role for their properties. To form the microphase-separated structure in polymers, they need to possess block structures, which blocks are chemically connected each other. It is well known that the polyurethane elastomers (PUEs), which possess multiblock structure, show the microphase-separated structure, resulting in giving some unique properties, such as mechanical properties and biocompatibility. The purpose of this study is the observation of the microphase-separated structure of PUEs using atomic force microscope (AFM).

## Experimental

PUE was synthesized from poly(oxypropylene) glycol (PPG), 4,4'-diphenylmethane diisocyanate (MDI) and 1,4-buthane diol (BD) by a prepolymer method. Hard segment content was 24 wt%. The phase-separated structure of PUE was investigated using AFM at various temperatures.

## Results & Discussion

At room temperature, we could see the microphase-separated structure, which is formed with crystalline hard segment domains and a rubbery soft segment matrix in the phase images. The hard segment domains exhibited smaller phase lag in comparison with a soft segment matrix. As decreasing temperature, a contrast, which is from the difference between phase lags of two phases in the AFM phase images, was weakened around the glass transition temperature of the soft segment (-60 ºC). This might be attributed to increasing modulus of a soft segment matrix by the transition from rubbery state to glassy one with decreasing temperature. This result implies that the phase images of PUE are due mainly to its viscoelastic properties. These temperature dependent AFM data support that the microphase-separated structure of PUE is properly observed and the phase image is closely related to the viscoelastic properties.