Fluorescent probe showing a two-step spectral change in response to polymer chain tension and strain-induced crystallization

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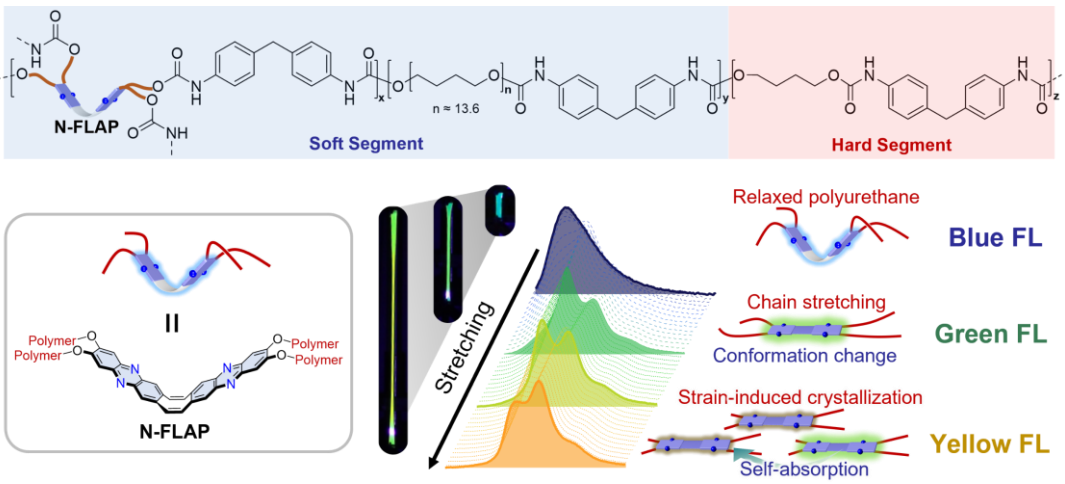
Strain-induced crystallization (SIC) is significantly related to the mechanical properties of polymers. There are many reports on the relationship between SIC and the resultant hardness.[1,2] However, the relationship between tension applied to the polymer chain and SIC has yet to be understood in detail. On the other hand, flapping molecules (FLAP) can be used as a force probe to quantify nanoscale tension in the entangled polymer chains.[3,4] In this study, we developed a novel approach to observe how the nanoscale tension causes the SIC of polymers using a FLAP fluorescent probe.

A nitrogen-embedded FLAP (**N-FLAP**)[5] was incorporated into segmented polyurethanes (PU) with high **N-FLAP** concentration (0.65 wt%), and their fluorescence response under external stress was investigated. Upon stretching the specimens, a blue fluorescence band was turned into a green fluorescence band in the low-stress region. The fluorescence color change can be explained as a V-shape-to-planar structural change of **N-FLAP** caused by the nanoscale tension in the polymer chain. Furthermore, a new yellow fluorescent band appeared as higher stress was applied to the PU. Detailed absorption and fluorescence analysis during stretching revealed that the second-step fluorescence color change was caused by self-absorption of the green fluorescence triggered by the SIC of the PU. As a result, polymer chain tension and SIC under external stress were both tracked by the two-step fluorescence spectral change.



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