Mechanoresponsive PDMS that Reversibly Changes Fluorescence in Sub-MPa Stress

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PDMS is a widely used polymer in biotechnology and electronics fields due to its biocompatibility, flexibility, transparency, and easy processability. In this study, we have developed PDMS elastomers that can quantitatively evaluate weak sub-MPa stress by ratiometric fluorescence analysis. In the PDMS, a flexible fluorescent force probe (FLAP) was chemically introduced into cross-linking positions of the polymer chain network. The FLAP molecule changes its fluorescent spectrum quickly and reversibly by its conformational change, thus FLAP can be used for real-time analysis of nanoscale stress concentration[1]. Stress-strain curve and viscoelasticity of PDMS with different compositions are analyzed, and then the relationship between mechanical properties and fluorescence response was investigated. In addition, by monitoring the fluorescence response associated with compression as well as stretching, the nanoscale stress concentration of PDMS will be analyzed.

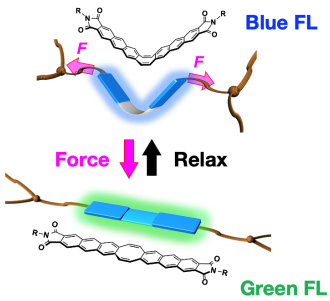

Fig. 1. Force-responsive fluorescence change of FLAP force probe.

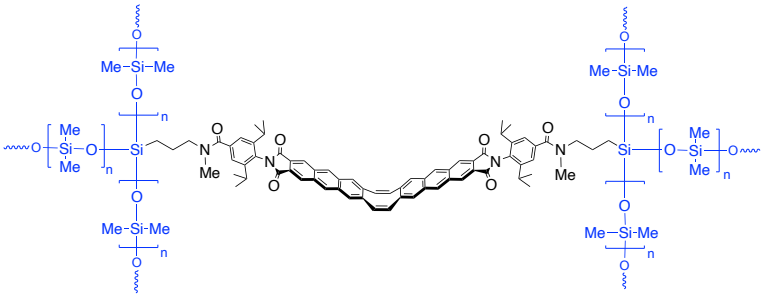

Fig. 2. Chemical structure of PDMS elastomer introduced with FLAP molecule at crosslinking points.

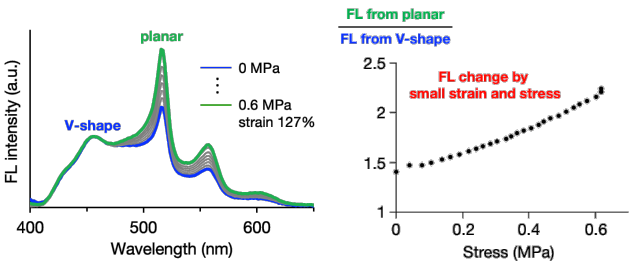

Fig. 3. Fluorescence changes and ratiometric fluorescent analysis of PDMS elastomer during elongational test.

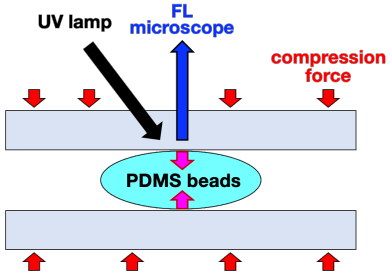

Fig. 4. Fluorescent stress analysis in PDMS beads during compression.

1) R. Kotani, S. Yokoyama, S. Nobusue, S. Yamaguchi, A. Osuka, H. Yabu, S. Saito, arXiv:2011.00202 (2020).