

## Single-Molecule Analysis of Structure and Dynamics in Polymer Materials by Super-Resolution Technique

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**Abstract :** The physical properties of polymer materials are dependent on the conformation and molecular motion of a polymer chain. Therefore, the structure and dynamic behavior of the single polymer chain have been the most important concerns in the field of polymer physics. However, it has been impossible to directly observe the conformation of the single polymer chain in a bulk medium. In the current work, the novel techniques to study the conformation and dynamics of a single polymer chain are proposed. Since a fluorescence method is extremely sensitive, the fluorescence microscopy enables the direct detection of a single molecule. However, the structure of the polymer chain as large as 100 nm cannot be resolved by conventional fluorescence methods because of the diffraction limit of light. In order to observe the single chains, we developed the labeling method of polymer materials with a photo-switchable dye and the super-resolution microscopy. The real-space conformational analysis of single polymer chains with the spatial resolution of 15-20 nm was achieved. The super-resolution microscopy enables us to obtain the three-dimensional coordinates; therefore, we succeeded the conformational analysis in three dimensions. The direct observation by the nanometric optical microscopy would reveal the detailed information on the molecular processes in the various polymer systems.

**Keywords :** polymer materials, single molecule, super-resolution techniques, conformation

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