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Dual In-Situ Transmission XRD for Perovskite Thin-Glass Encapsulation and Nylon 5,6 Drawing

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Analyzing material structure by X-ray diffraction in real time is crucial because it probes physical properties during deformation rather than only after the material has stabilized. To this end, we built two in-situ X-ray diffraction systems that monitor nylon 5,6 fibers and perovskite thin films, respectively. For the fibers, drawing above Tg induces polymer-chain orientation and markedly increases mechanical strength. To observe this process, we developed a heater-integrated X-ray transmission drawing stage. With the fiber axis aligned to the beam, WAXS patterns were collected, and the (004) reflections were analyzed to quantify phase fraction, orientation, and lattice strain. The results show a continuous γ→α structural transition during drawing, followed by additional growth of the α component during unloading and cooling. For the perovskite films, we measured degradation behavior in real time. Reflection-mode measurements in air often fail to secure reliable diffraction signals because the encapsulation cover perturbs the optical path. To overcome this, the perovskite was coated on ~150 μm glass and an equally thin glass was used as a cover to enable transmission. The sample was then sealed under N_2 and monitored with a transmission in-situ setup. GIWAXS tracked lattice-parameter shifts, peak-width changes, and the emergence of PbI_2 diffraction, enabling simultaneous quantification of early-stage degradation, phase segregation, and texture evolution. Leveraging these real-time in-situ methods provides structural information that explains—and helps predict—the physical properties of diverse materials.

Paper submission Plan

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Best Presentation

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Primary author: JO, Kukhyun (Institute of Advanced Organic Materials, Pusan National University, Busan 46241, Republic of Korea)

Co-authors: Ms SONG, Ji Hee (Department of Organic Material Science and Engineering, School of Chemical Engineering, Pusan Natic
KIM, Hyo Jung (Department of Organic Material Science and Engineering, School of Chemical Engineering, Pusan National University, Bu
LEE, Hyun Hwi (Pohang Accelerator Laboratory, Pohang University of Science and Technology, 80 Jigokro-127-Beongil,
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Presenter: JO, Kukhyun (Institute of Advanced Organic Materials, Pusan National University, Busan 46241, Republic of Korea)

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