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Kinetic features of pattern transformation and recovery in periodic hydrogel membranes XUELIAN ZHU, RONG DONG, JI FENG, CHI-MON CHEN, SHU YANG, University of Pennsylvania, DEPT. OF MATER. SCI. & ENG., UNIV. OF PENNSYLVANIA TEAM — Pattern transformation triggered by mechanical instabilities is an attractive bottom-up method to create complex structures over a wide range of length scales. However, how to dynamically control the transformation and its recovery is yet to be studied. Here, we present a systematic study of the kinetic pattern transformation and its recovery using a model system from poly(2-hydroxyethyl methacrylate) hydrogel membrane with a square lattice of micron-sized cylindrical holes. The hydrogel membrane undergoes (1) a breathing mode (i.e. the hole reduces size but retains the shape) when exposed to DI-water; (2) a phase transition to a diamond plate pattern driven by capillarity during drying process; and (3) a recovery upon re-exposure to water. During drying, many antiphase boundaries (APBs) appear in the diamond plate pattern, which then act as embryos that determine the kinetic path for recovery. The boundary morphology (either random or aligned) can be manipulated by the moving speed of the waterfront. To reveal the underlying mechanism of pattern transformation and APB arrangement, as well as the role of APB in recovery, we utilized the dynamic Monte Carlo method to simulate the kinetic process of pattern transformation and recovery, which qualitatively matched well with the experiments.

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