Formation of latex films with high toughness

([1] *Graduate School of Textile Science & Technology, Shinshu University,* [2]*Research Initiative for Supra-Materials, Interdisciplinary Cluster for Cutting Edge Research, Shinshu University,* [3]*Graduate School of Science and Technology, Hirosaki University,* [4]*Yokohama Rubber Co., Ltd.,* [5]*Department of Chemical Science and Engineering, Tokyo Institute of Technology,* [6]*Graduate School of Advanced Science and Engineering, Hiroshima University*)
○Yuma Sasaki,[1] Yuichiro Nishizawa,[1] Hayato Suzuki,[1] Takuma Kureha,[3] Kazuya Uenishi,[4] Kazuko Nakazano,[5] Toshikazu Takata,[6] Daisuke Suzuki,[1,2]
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Polymeric materials are lighter, softer, and processable than other materials such as metals and ceramics due to their low density and the modulus, and are applied as components in automobiles, aircraft, and building materials. In various polymer material applications, there is a need to ensure long-term durability for safe and reliable use, and there is growing interest in the preparation of tough polymer materials and the elucidation of their fracture mechanisms. Against this background, our group have achieved toughening of latex film by introducing rotaxane crosslinker (RC) into microparticles.[1] The results show that the introduction of RCs improves the mechanical properties of polymer microparticles and is also important in strengthening the particle interface without additives. Furthermore, understanding the fracture behavior of latex films when various defects such as cracks and scratches are introduced is highly important as a strategy for tough polymeric materials in terms of green chemistry. In this study, we investigated the effect of RC in microparticles on the fracture of the film interface.

Tear tests showed that the cracks propagated horizontally in films with non-crosslinked or chemically crosslinked particles, while cracks propagated in an irregular direction when RC was introduced (**Fig.(a,b)**). The fact that the crack growth occurred at a sufficiently slow rate suggests that the RC in the microparticles is effective in dissipating stresses at the boundary of microparticles in various directions in the film.

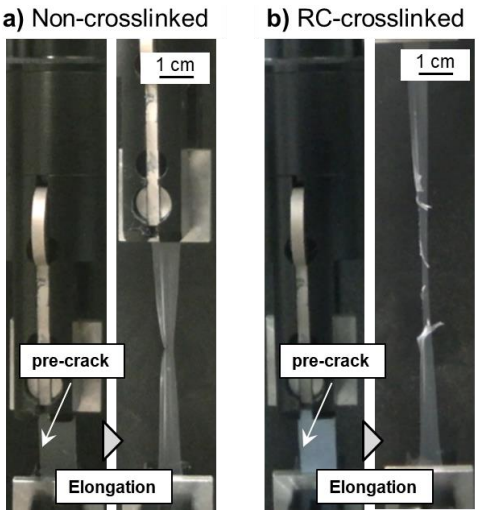

Figure. Photographs of before/after elongation notched **(a)** Non-crosslinked, **(b)** RC-crosslinked latex films.

1) a) S. Hiroshige *et al.*, *Chem. Eur. J.* **2017**, *23*, 8405. b) T. Kureha *et al.*, *Langmuir* **2020**, *36*, 4855. c) S. Hiroshige *et al.*, *J. Soc. Rheology, Jpn.* **2019**, *47*, 51.