A Photostable Gel that Degrades by Simultaneous Treatment with Acid and UV Light for Phototuning of Optical Functionalities

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Photodegradable materials exhibit on-demand phototunability with high spatiotemporal resolution and have gained importance in various applications.[1] However, due to their photoinstability, they can only be used transiently in most environments. Namely, the trade-off between photodegradability and photostability has limited the potential applications of photodegradable materials in naturally lit environments.

To realize a material that is both photostable and photodegradable, it is desirable for the material to be switched from photostable to photodegradable states in the presence of a particular chemical additive. In our previous study, we found that the photostable platinum-acetylide conjugated polymers cleaves by a combination of HCl and UV light.[2] In this study, we applied the reactivity of platinum-acetylide complex to polymer network materials to realize a photostable gel that can be converted into a photodegradable state by the addition of an acid, and into a photostable state by the removal of the acid (Fig. 1a).

Pt gel, a gel incorporating a platinum-acetylide cross-linker encapsulated by permethylated α-cyclodextrin (PM α-CD) was synthesized. When exposed to UV light under HCl solution, **Pt gel** underwent significant softening by the cleavage of the platinum-acetylide cross-linker (Fig. 1b). Conversely, when the acid was removed from the gel, its photostability was restored. By utilizing luminescence changes caused by decrosslinking, sub-millimeter-sized luminescent characters were photopatterned on the transparent gel (Fig. 1c). The characters were readily visualized without degradation under UV light while remained invisible under white light. Therefore, this technology expands the scope of photoprocessing applications for utilization under illumination.

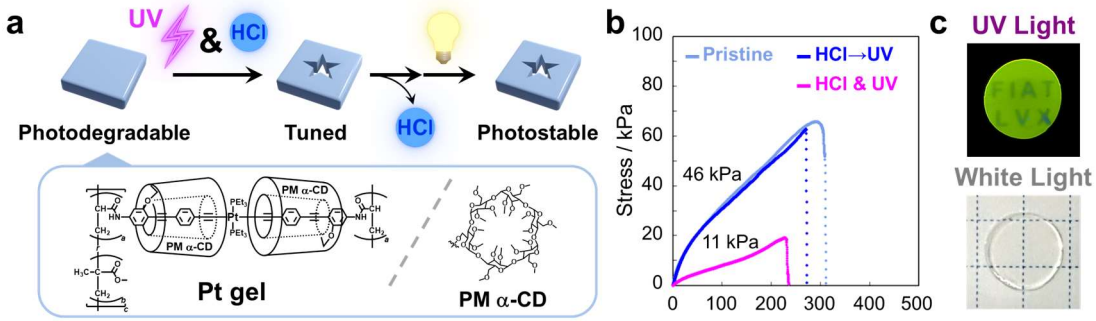

Figure 1. a) Behavior and structure of the synthesized material in this work. b) Stress-strain curves of **Pt gel** before and after exposure to stimuli either sequentially or simultaneously. c) Photographs of photopatterned **Pt gel** under (top) 365 nm excitation and (bottom) white light.

1) L. Li, *et al. Adv. Mater.* **2019**, *31*, 1807333. 2) J. Terao, *et al. Polymers* **2020**, *12*, 244.