Photo-induced spatial control of out-of-equilibrium network pattern of peptide nanofibers in a supramolecular double network hydrogel

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In living cells, cytoskeletal proteins orthogonally self-assemble to form self-sorted nanofibers, which in some cases cooperatively work to control the spatial organizations and the collective motions. Such precise control of interactions between self-sorted nanofibers would be invaluable to design artificial intelligent soft materials. However, there have been limited varieties of such synthetic materials. Herein, we developed a self-sorting double network (SDN) hydrogel composed of a lipid-type gelator and a light-responsive peptide-type gelator bearing an acylhydrazone moiety. Upon photo-irradiation with a photomask, the peptide nanofibers in a photo-irradiation area were selectively decomposed through the light-induced *E*-to-*Z* isomerization of the acylhydrazone moiety, as confirmed by *in situ* confocal laser scanning microscopy imaging. During incubation under dark after the photo-decomposition, the gradual reformation of the peptide nanofibers in the photo-irradiation area took place through the *Z*-to-*E* isomerization of the acylhydrazone moiety. In sharp contrast, such reformation was never observed in the single component peptide hydrogel. These suggested that interactions between the lipid fibers and the collapsed peptide aggregates/monomers would be important to suppress the diffusion of the peptide aggregates/monomers. Surprisingly, subsequent incubation of the photo-irradiated SDN hydrogel under dark caused formation of the denser network of the peptide nanofibers in the photo-irradiation area. In this presentation, I'll also discuss the mechanisms in detail.