

## Biomimetic Stimuli-Responsive Membrane with Multiple On-Off Gates

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Stimuli-responsive polymers have been widely used for controlled release of several biomolecules. In general, a single stimulus among various stimuli, for instance, temperature, pH, or light, has been used for these polymers. Although some stimuli are applied together, one cannot control each stimulus independently at a given stimulus-responsive polymer. However, to mimic biological system like cell membrane, multiple on-off gates utilizing independent control of dual (or multiple) stimuli should be used. Here, we introduce a stimuli-responsive membrane controlled by two orthogonal stimuli. For this purpose, the top and the bottom parts of anodized aluminum oxide membrane walls are independently grafted by thermoresponsive poly(Nisopropylacrylamide) and pH-responsive poly(acrylic acid), respectively, by using surface-initiated atom transfer radical polymerization. The membrane clearly showed two independent on-off gates depending on temperature and pH. Furthermore, through light irradiation of two different wavelengths (near-infrared and ultraviolet), temperature and pH were also controlled independently and promptly.