Development of a Novel Thiourea-Based Underwater Adhesive

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Nowadays, various types of adhesives have been developed, but adhesives that can adhere in water have not been fully explored yet due to the inhibition of adhesive-surface interaction by water molecule. For example, epoxy-based adhesives are already commercially available, but they have problems such as low adhesive strength and long curing time. To overcome these problems, many groups have reported that polymers containing catechol groups synthesized by mimicking mussels have underwater adhesive properties.[1] However, catechol groups are known to be naturally oxidized and lose their adhesive strength over time. In other words, no underwater adhesive satisfies all the requirement such as high adhesive strength, rapid curing, and excellent durability.

In 2018, our lab reported a mechanically robust but self-healable polymeric glass using a molecular motif of thiourea.[2] Based on the molecular structure of this material, we designed a novel photopolymerizable molecule that can work as an efficient underwater adhesive (Fig. 1). This material can adhere two glass slides under water only with 10 sec photo irradiation. The adhesion is very strong so that the adhered state can be maintained even under 100 g load. Based on a tensile shear test, we found that the underwater adhesive strength was higher than the highest value in the previous report.[3] We also found that our novel adhesive can work even under sea water.

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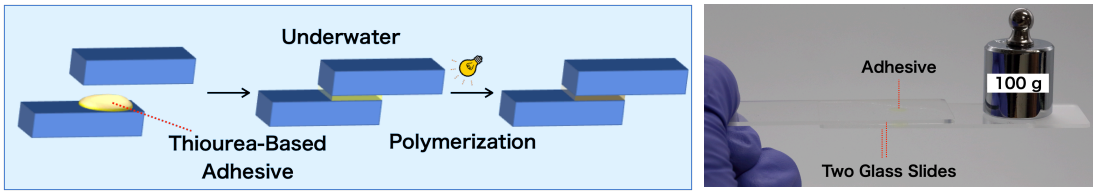

Fig. 1 Schematic image of thiourea-based underwater adhesive.