Docket #: S23-010

Multi-layer self-healing devices using immiscible dynamic polymers

Researchers at Stanford University have developed a multilayered immiscible polymer system capable of autonomously realigning its layers to enhance the healing process after damage. Self-healing polymers, which can recover from various forms of damage, often include conductive or dielectric particles for added functionality and are typically arranged in a multilayer configuration. While these polymers usually self-heal effectively when layers are aligned, misalignment can significantly reduce healing efficacy. To address this, Stanford researchers created a laminate with immiscible dynamic polymers, each with the same dynamic bond for strong interlayer adhesion but different backbones for interfacial tension-mediated realignment. This design ensures complete self-directed structural and functional recovery after damage.

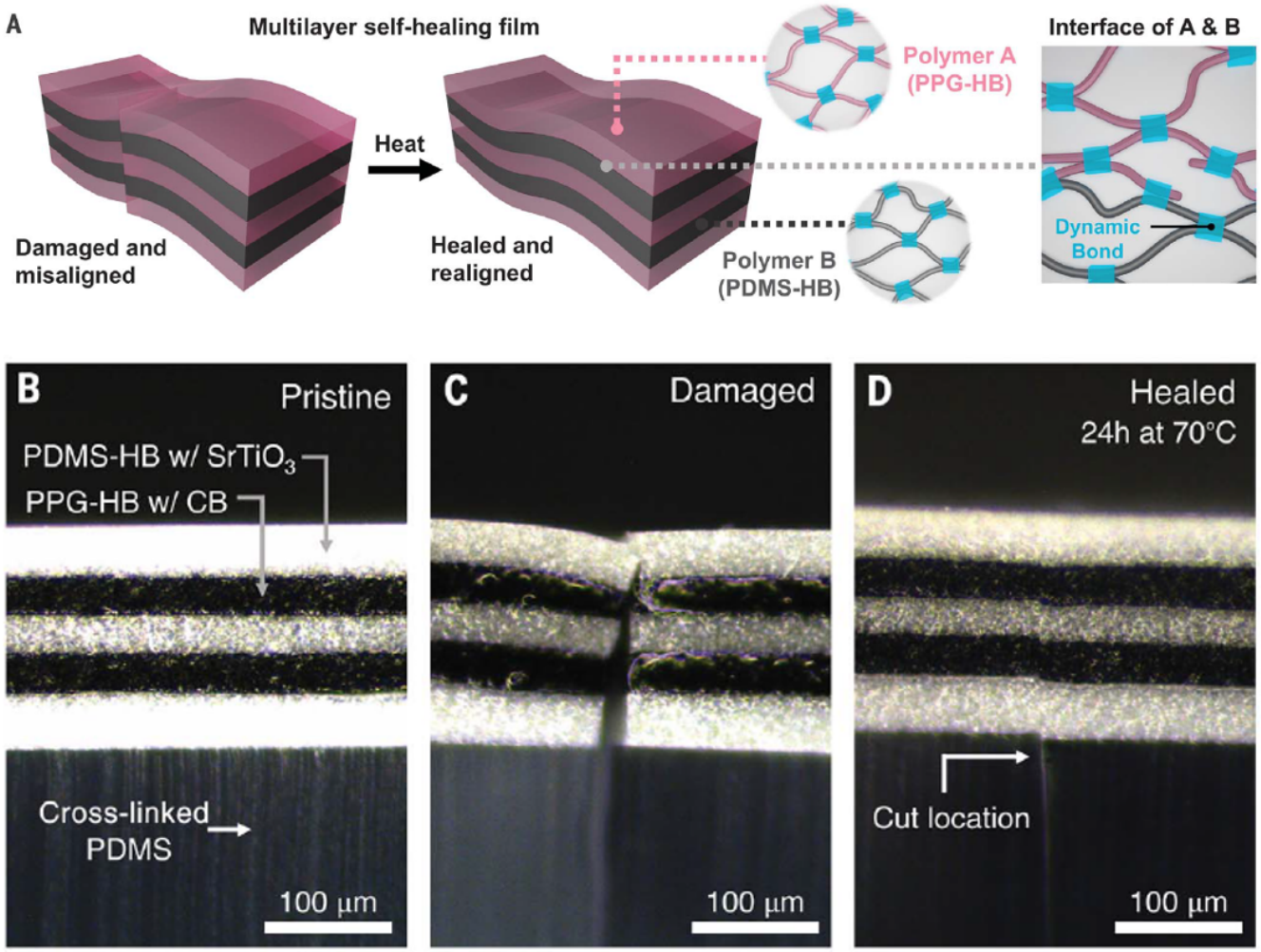


FIgure 1. A) Schematic showing the principle of surface tension–mediated realignment and healing of a fractured multilayer laminate. B) Before damage, C) after damage, and D) after healing (Adapted from Figure 1 and 4 in Cooper *et al.* (2023)).

Stage of Development

Proof of concept

Applications

- Soft robotics
- Surgical modeling
- Films and coatings for industrial uses
- Implantable flexible electronics
- Wearable flexible electronics

Advantages

- Less risk of misalignment and functional loss
- Can incorporate multiple functions
- Inspired by the human skin healing process
- Potential for countless applications with other immiscible polymers

Publications

- Cooper, C. B., Root, S. E., et al. (2023). Autonomous alignment and healing in multilayer soft electronics using immiscible dynamic polymers. *Science, 380(6648)*, 935–941.

Patents

- Published Application: 20240246327
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