A biologically muscle-inspired polyurethane with super-tough, thermal reparable and self-healing capabilities for stretchable electronics

WUBIN YING[1,2], Ruoyu Zhang[3], Jin Zhu[3], 이경진[4], 김도환[2,†]

[1]Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Science;

[2]한양대학교; [3]Chinese Academy of Sciences; [4]충남대학교

(dhkim76@hanyang.ac.kr[†])

Polymeric elastomers play an increasingly important role in the development of stretchable electronics. A highly demanded elastic matrix is preferred to own not only excellent mechanical properties, but also additional features like high toughness and fast self-healing. Here, we synthesized a polyurethane (DA-PU) with donor and acceptor groups alternately distributed along the main chain to achieve both intra-chain and inter-chain D-A self-assembly, which endow the polyurethane with toughness, self-healing and, more interestingly, thermal repair, like human muscle. In detail, DA-PU exhibited an remarkable mechanical performance, anti-fatigue and anti-stress relaxation properties as manifested by cyclic tensile and stress relaxation tests, respectively. Even in case of large strain deformation or long-time stretch, it could almost completely restore to original length by thermal repair at 60℃ in 60s. The self-healing speed of DA-PU could be 1.0 ~ 6.15 μm/min from 60℃ to 80℃. At last, a stretchable and self-healable capacitive sensor was constructed and evaluated to prove that DA-PU matrix could ensure the stability of electronics even after critical deformation and cut off.