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In-situ rubber matrixes (iRUM) for elastic and photo-patternable semiconductors

Stanford inventors have developed a molecular design concept that allows for the development of stretchable electronics with desirable elasticity, solvent resistance, and photopatternability using covalently-embedded in-situ rubber matrix formation (iRUM). iRUM precursors offers improved miscibility, increases charge transport reactivity, and enables improved crosslinking density of composite films. The iRUM approach results in elastic and photo-patternable transistors that can retain charge carrier mobility even after stretching to 100% strain. The resulting stretchable material can also achieve high mobility retention after 1000 stretching-releasing cycles at 50% strain, and achieve stable 5000 cycle lives which is 5 times longer than previously reported methods. The inventors additionally fabricated a fully patterned, elastic transistor array by consequtively photo-patterning dielectrics and semiconductors to demonstrate multi-layer device fabrication.

Stage of Development
The inventors have fabricated a fully patterned elastic transistor, demonstrating the feasibility of integrated solution-processed electronics manufacturing

Applications

- Stretchable transistors
- Flexible LED screens
- Soft sensors
- Flexible electronics

Advantages

- Rational designed materials enable desirable elasticity, solvent resistance, and patternability
- Previous stretchable electronics have poor electrical or mechnical performance and have limited scalable production
- Previous methods experience device failure or deformation under low strain due to crystalline morphology
- Previous methods to pattern devices result in poor device uniformity and mechanical properties

Publications

- Zheng Y, Yu Z, Zhang S, Kong X, Michaels W, Wang W, Chen G, Liu D, Lai J-C, Prine N, Zhang W, Nikzad S, Cooper CB, Zhong D, Mun J, Zhang Z, Kang J, Tok JB-H, McCulloch I, Qin J, Gu X, Bao Z. 2021. A molecular design approach towards elastic and multifunctional polymer electronics. Nat Commun 12:5701.

Patents

- Published Application: 20230163368

Innovators

- Yu Zheng
- Zhenan Bao
- Zhiao Yu

Licensing Contact

Evan Elder

Senior Licensing Associate

Email