# A Variable Stiffness Artificial Muscle Material for Soft Robotics

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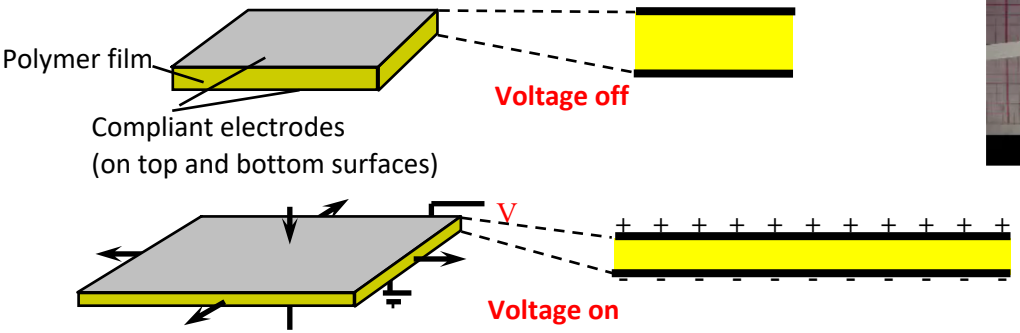
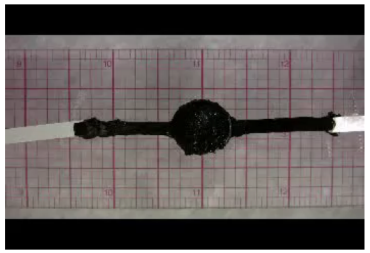
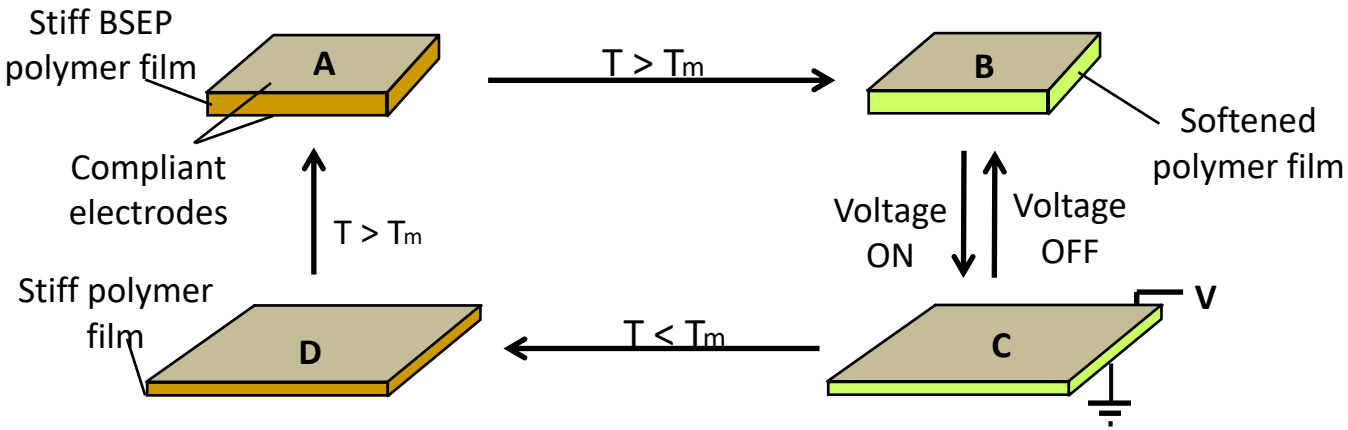
Soft Dielectric Elastomer Actuation (DEA)



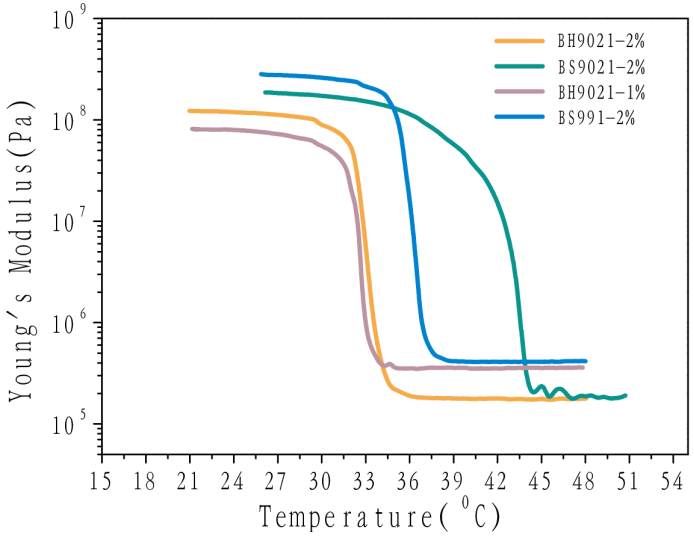



Bistable Electroactive Polymer (BSEP) combining SMP and DEA funtionalities

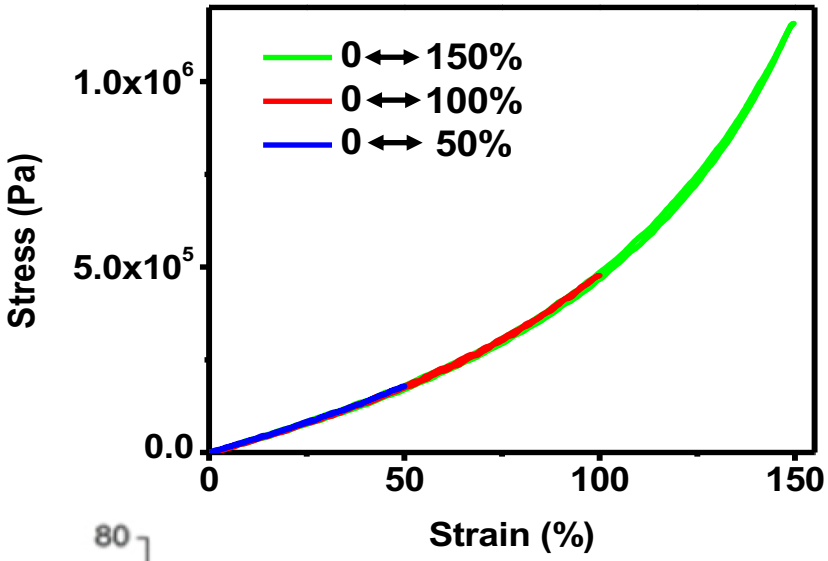


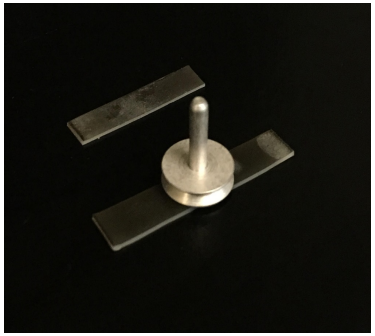
# Bistable Electroactive Polymer (BSEP)

Phase Transition is tunable and narrow



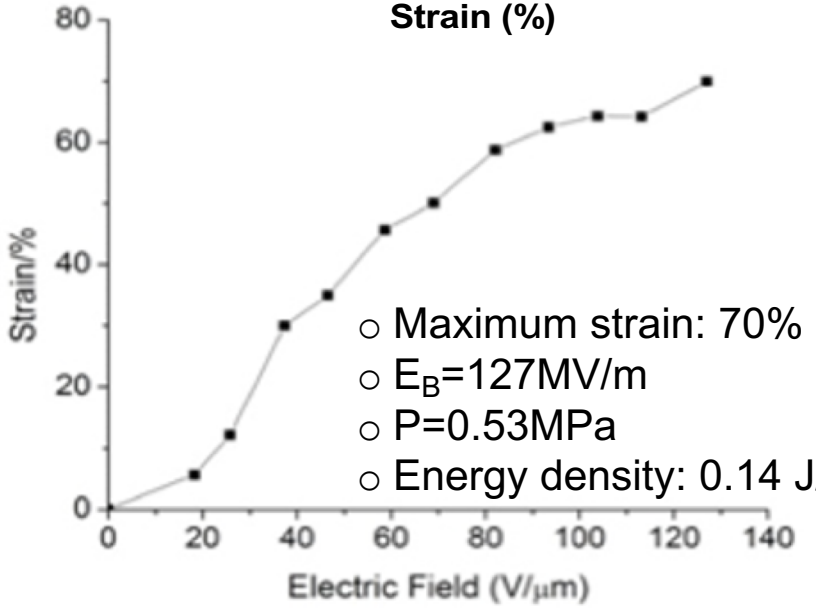

Rubbery elasticity above transition T



Heat to 45°C

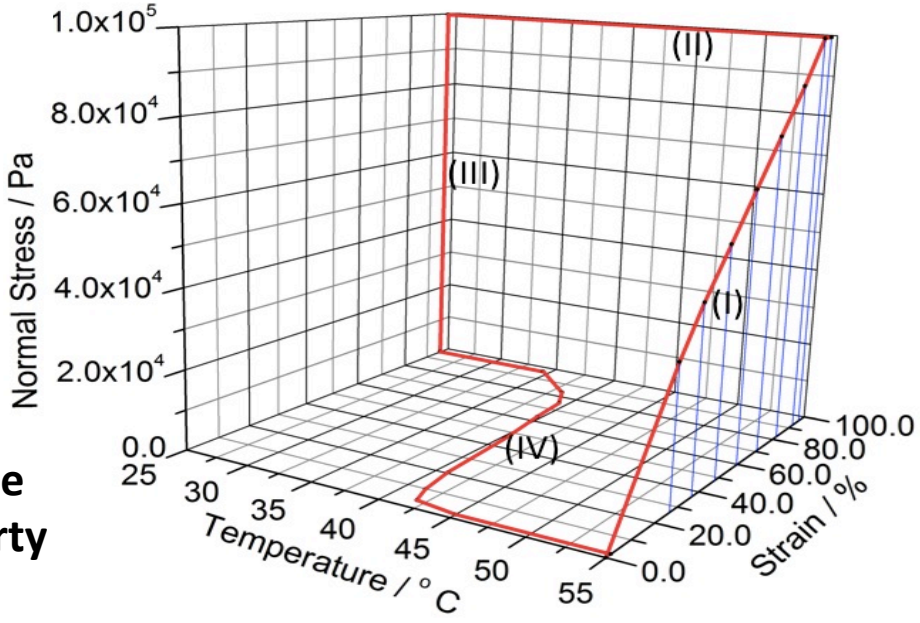
Rigid → Soft

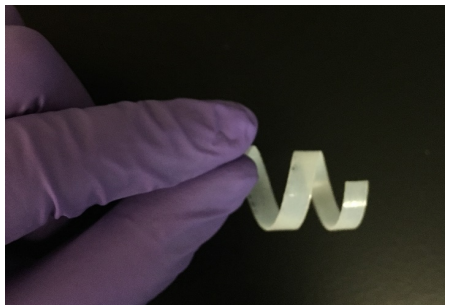



- Maximum strain: 70%
- $E_B$=127MV/m
- P=0.53MPa
- Energy density: 0.14 J/cm$^3$

# Bistable Electroactive Polymer (BSEP)

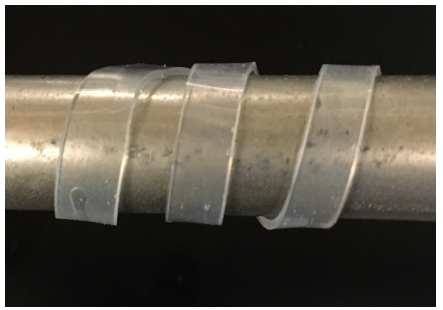
**Excellent shape memory property**



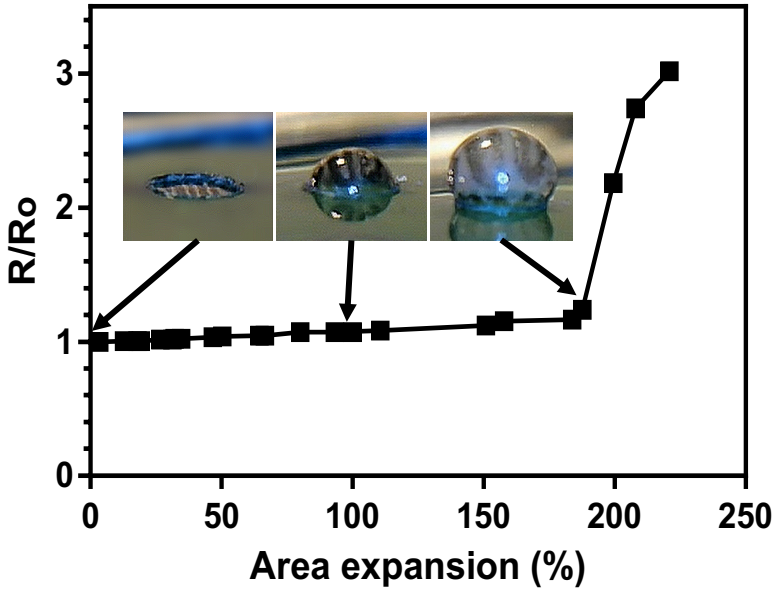
As-polymerized spiral film

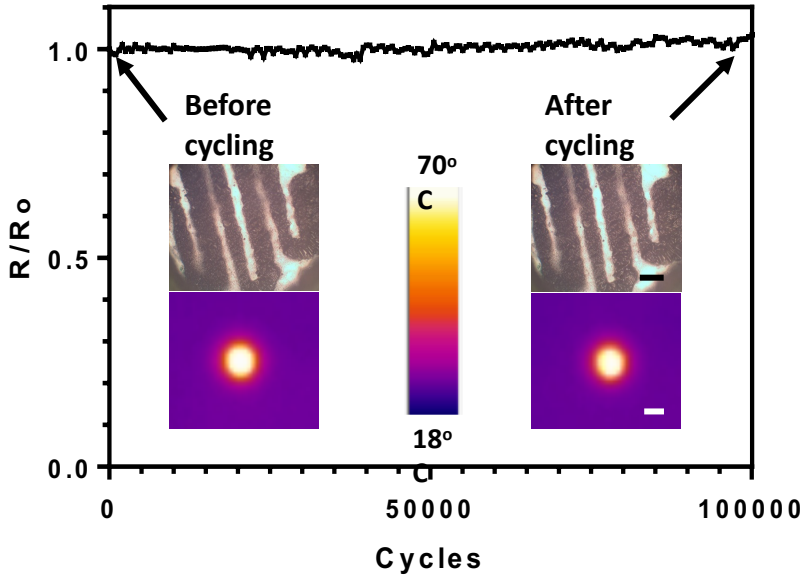
Temporary shape

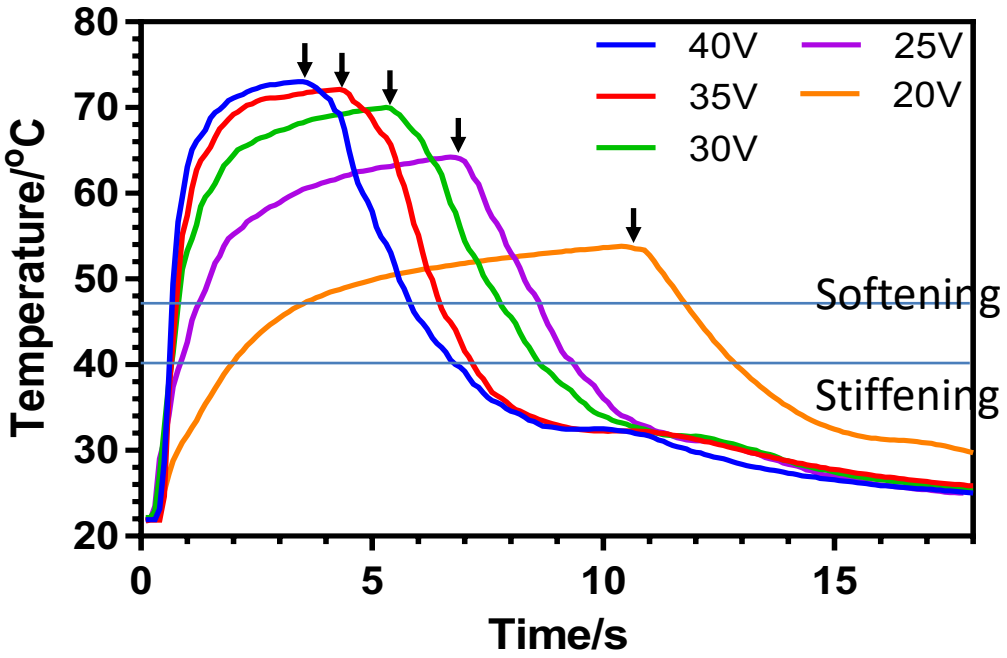


Shape recovery along a heated tube

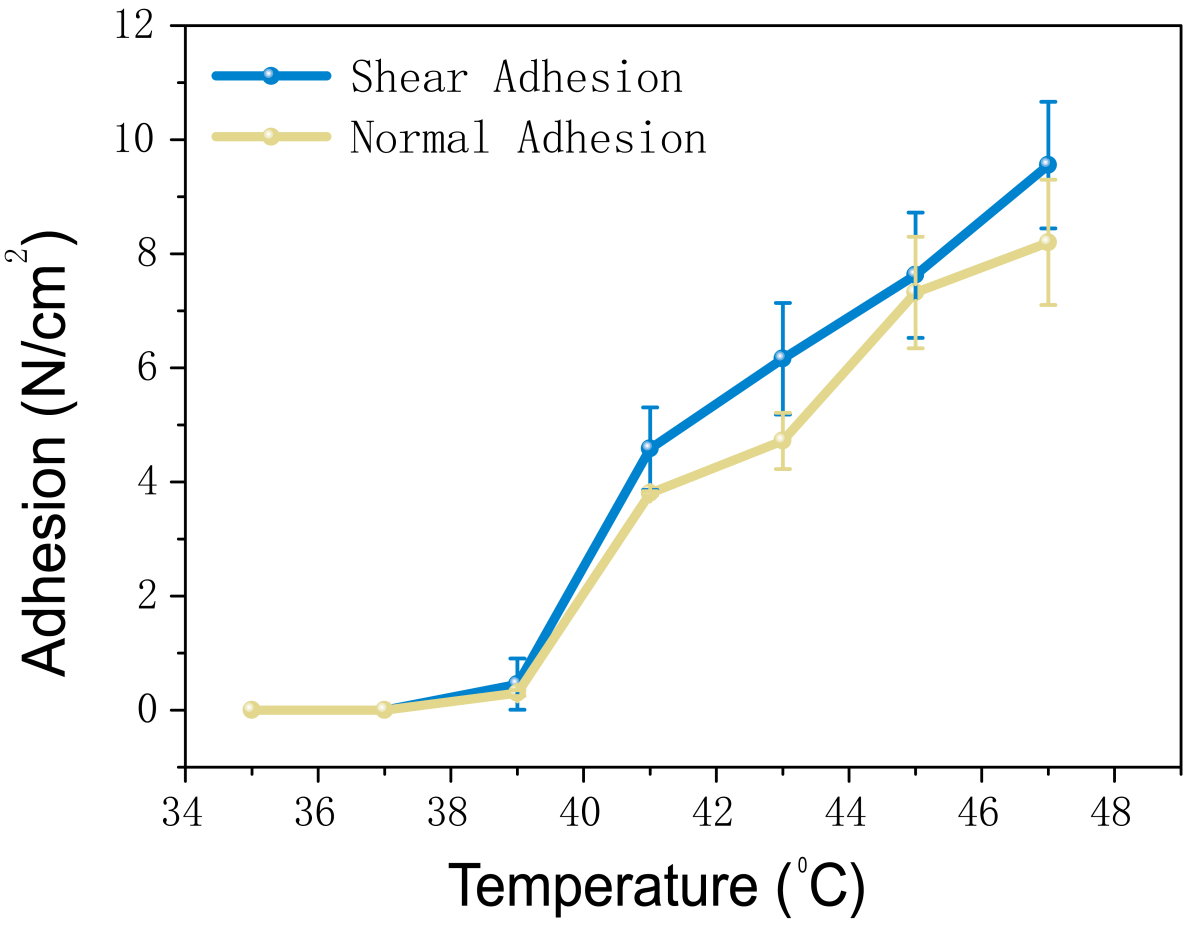
# Compliant Heating Electrode



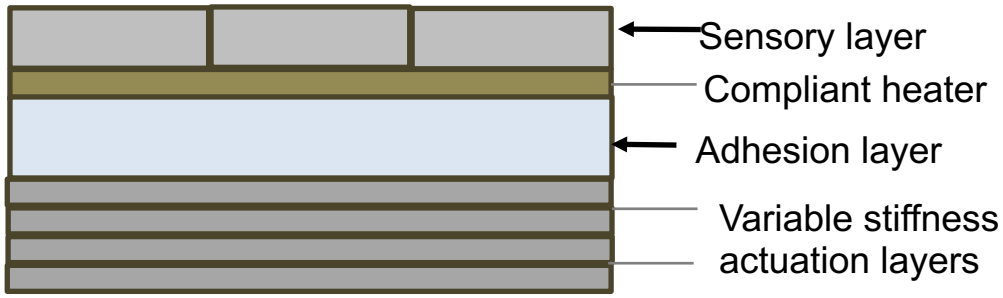



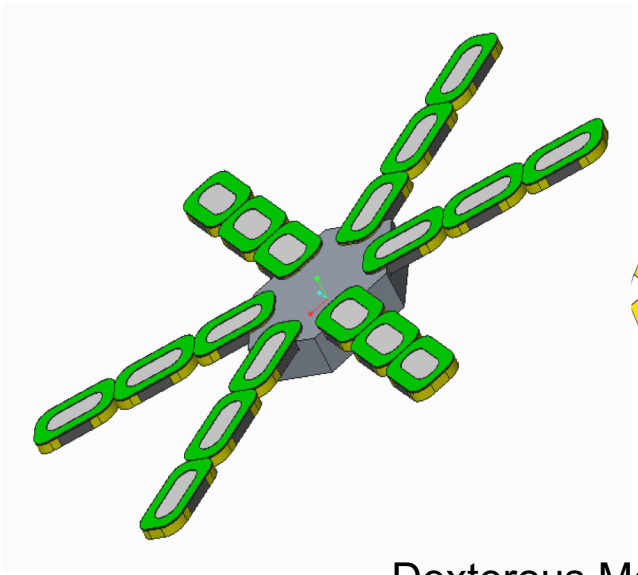



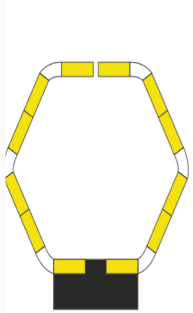
# Reversible Adhesion

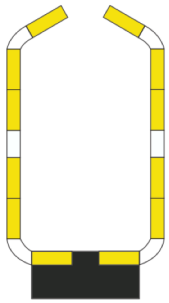


# BSEP Dexterous Manipulator







Dexterous Manipulator

Mechanism
Demonstration