will meet biweekly to update progress and make future plans. Each GRA will also have an individual meeting with at least one PI per week to receive hands-on guidance on research procedures and skills.

6. BROADER IMPACT

The proposed research will give a definitive answer to the long lasting debate of the suction effect at micro- or nano-scale. The adhesion mechanism map to be developed for cratered polymers across multiple length scales will be able to fundamentally decipher the myths of SC based adhesives. It will also guide the rational design of mechanically enhanced reversible adhesives whose strength may outperform gecko-inspired microfibrils. In addition, SC based adhesives may exhibit some unique behavior such as preload dependent and orientation dependent adhesion. These features will enable SC based mechanical adhesives to find wide applications in vertical mounting and climbing, releasable wafer and residual-free nanomembrane handling, conformable and reusable electronic medical patches, and so on. The overall impact on science and technology is expected to be comparable or even exceed gecko-inspired micro-pillars.

7. RESULTS FROM PRIOR NSF SUPPORT

CMMI # 1301335: Adhesion Mechanics of Bio-Electronics Interface
PIs: N. Lu, Co-PI: Kenneth Liechti, 6/1/2013 - 5/31/2016, $360,780.
Intellectual merit: The *objective* of this study is to measure and model the native interfacial adhesion between polymers or metal coated polymers and bio-tissues using a contact mechanics approach. The intellectual merit derives from the complexity associated with the contact of bio-tissues through viscoelastic effects, surface topology, as well as the presence of bio-fluid at the interface. During the 32 month funding period (6/1/2013-2/15/2016), the PIs were able to publish eight high-quality refereed journal articles [22, 70, 82-87], two refereed conference proceedings [88, 89], and one Master thesis [90].
Broader impact: Three graduate students and two Hispanic undergraduate students (Daniel Sanchez and Federico Salinas) were supported on this grant. The PIs and the students have given more than 20 talks about the supported research in international conferences and workshops. The PI's lab open house has demonstrated epidermal electronics to K-12 students in two consecutive Explore UT events. The PI has hosted one visiting undergraduate minority student, Cara Lauber, from Texas Tech University.
Relevance to proposed research: The double cantilever beam apparatus built in this project for the measurement of polymer interface traction separation relation will be used for characterizing the adhesion of cratered polymers in this proposal, as discussed in **Section 3.2**. Also, the adhesion values of flat surfaces can be compare with the SC adhesion.
CMMI 1130261: Probing the Adhesive Properties of Graphene
PIs: Kenneth Liechti, Rui Huang and Rod Ruoff, 9/1/11-8/31/14, $450,000.
Intellectual merit: The *objective* of this study was to develop experimental methods to measure interfacial adhesion between graphene and other materials including copper and silicon. Experiments using micro bulge/blister and sandwich beam fracture tests were developed and continuum level models have been employed for property extraction. As a result, adhesive properties have been measured for graphene transferred to silicon and copper. Multiscale models have been developed to examine interactions between graphene and substrates. The research has resulted in the publication of twelve journal articles [54, 57, 59, 91-99] and three PhD dissertations [100-102].
Broader Impacts: Four graduate students and two Hispanic undergraduate students (Joshua Montanez and Daniel Sarceno) were supported on this grant. Outreach links were established with Manor New Technology High School in Manor, Texas (near Austin) which opened in 2007 and had its first graduating class in May 2010. It is one of the 35 original Texas Science, Technology, Engineering and Mathematics (T-STEM) Academies. The PI (Liechti) has made presentations to the freshman class and participated in a summer intern program.
Relevance to proposed research: The development of infrared crack opening interferometry to measure normal crack opening displacements in double cantilever beam specimens will be employed as an established tool in the proposed research.