CAREER: Impact-Adaptive Conducting Polymers

Yue Wang, University of California, Merced

- Organic electronics are cost-effective but vulnerable to impact, especially at fast rates. Our project developed a counterintuitive polymeric electronic material that becomes tougher under stronger or faster impact.
- Understanding the mechanism behind this counterintuitive property is of paramount importance and has been the focus of our recent exploration:
  - Interconnected core-shell micelles of conductive polymers are the fundamental building blocks (Fig. 1a) of rate-adaptive toughness and extensibility (Fig. 1b).
  - This adaptive property has been found to be a result of the chemical interactions within or between core, shell, plasticizers, and fillers (Fig. 1c).
  - High aspect ratio polyaniline fibers (Fig. 1e) were developed to study the effect of fibrous fillers on the rate-adaptive properties.
  - Acidic (PSA), alkaline (13DA), and neutral (Gly) plasticizers (Fig. 1d) were employed to decipher the effect of plasticizers on the rate-adaptive properties (Fig. 1f).

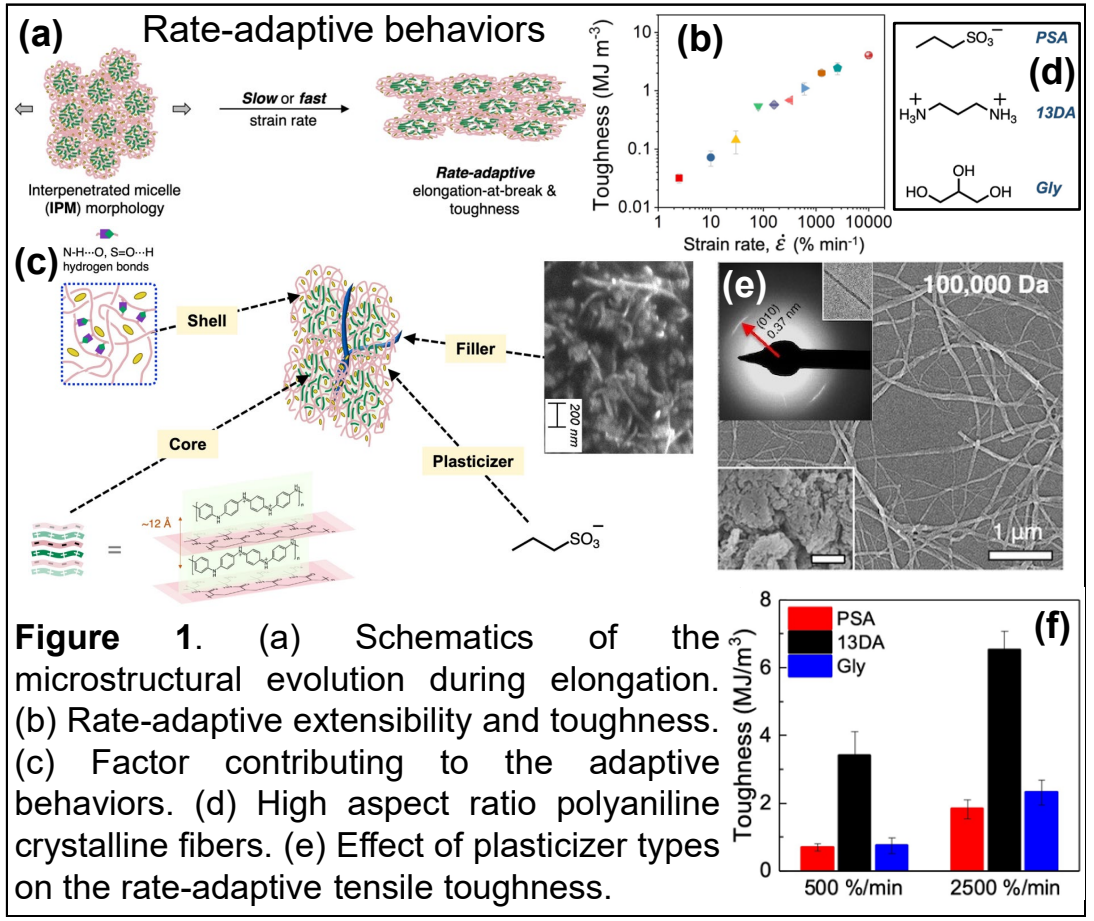

Figure 1. (a) Schematics of the microstructural evolution during elongation. (b) Rate-adaptive extensibility and toughness. (c) Factor contributing to the adaptive behaviors. (d) High aspect ratio polyaniline crystalline fibers. (e) Effect of plasticizer types on the rate-adaptive tensile toughness.

Dynamically Adaptive Conducting Polymers

Yue Wang, University of California, Merced

- Our projects have engaged over 10 undergrads, most of them are underrepresented minorities or female engineers.
- We developed a 1-week summer camp on 3D printing of polymers for local 6-8th graders, offered virtually for now (Fig. 2a). Students learned about rheology using kitchen supplies and modeled the 3D printing extrusion process using piping bags and mashed potato.
- We developed another half-day 3D printing workshop for local 10-12th grade students. We demonstrated light-based printing and taught them about photopolymerization. Students printed out fun objects during the workshop for them to take home as a souvenir (Fig. 2b-d)
- The Central CA is an economically and financially underserved region, with a large population of underrepresented minorities. Through fun activities, both workshops have educated students about the properties and pervasiveness of polymers, what is materials science, and how STEM is accessible and its power to transform the society and our lives.

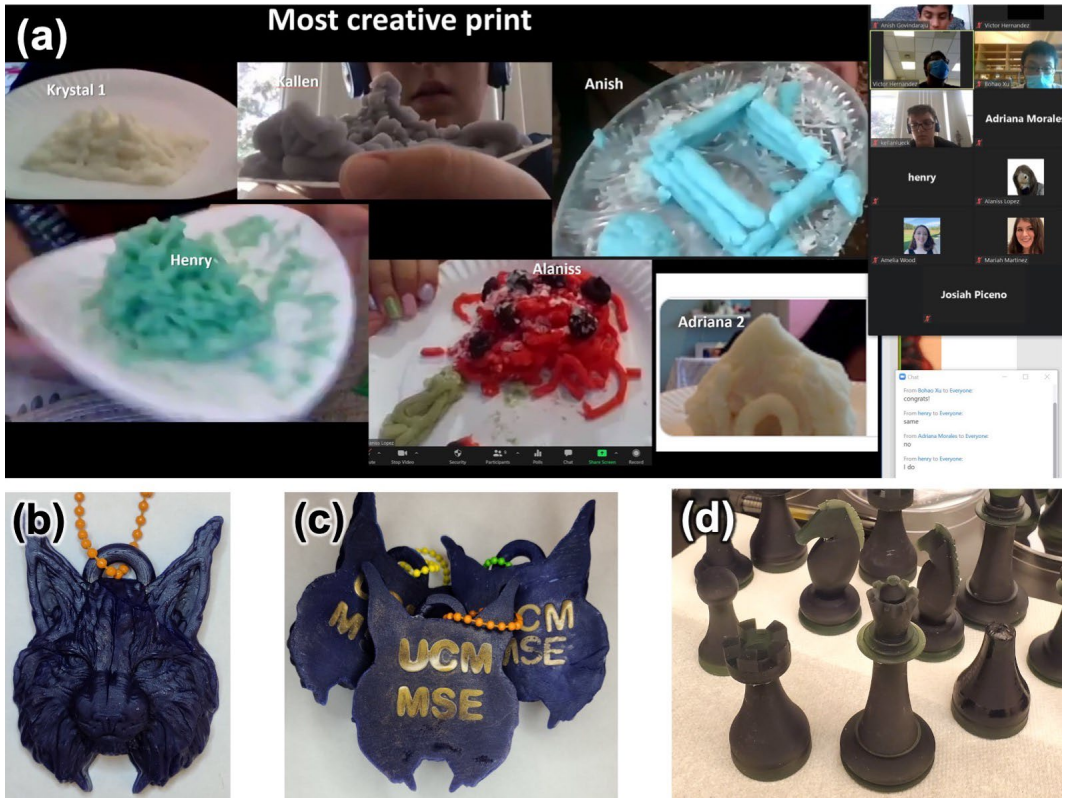

Figure 2. (a) Zoom outreach workshop on 3D printing of polymers. (b)-(d) 3D printed end-products (take-home souvenirs) containing conducting polymers in the dedoped (blue) and doped (green) states: (b)-(c) front and back of bobcats (UCM mascot), and (d) chess pieces.