QUANTIFICATION OF POLYMERIZATION AND BACKBONE DISRUPTION IN POLYDIACETYLENE-BASED SPRAY-ON SENSORS

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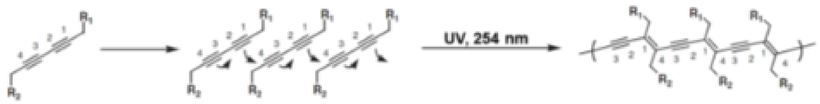
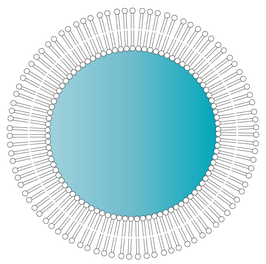
BACKGROUND

Polydiacetylene (PDA) is an organic polymer containing elongated Pi-systems resulting in a color shift in UV light.

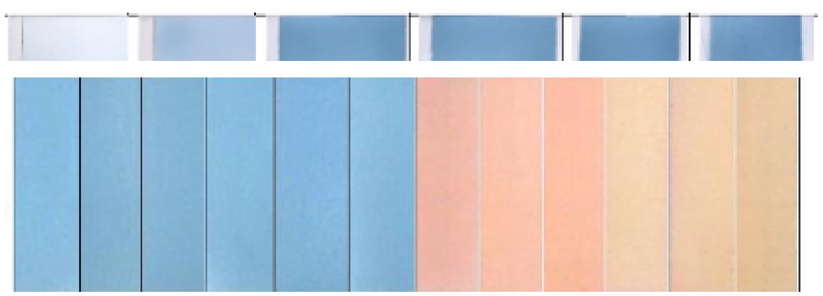


This elongated chain on conjugated bonds allows for certain stimuli to disrupt them, resulting in a color shift response to the stimulus. This makes PDA-based sensors a promising area, although much of the research on PDA-based sensors involve their usage in liquid phase as vesicles due to their long hydrocarbon tails.



Here, we examine the response of PDA in a spray-on form, which if turned correclty, could allow for usage as a wearable sensor. This could improve workplace safety and allow for future improvements in wearable sensors.

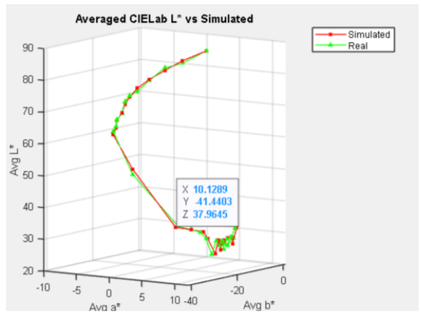
DEMONSTRATION



Above are various concentrations of PDA after being UV lamp activated for 10 seconds. Then, various filter material and their response to heating up to 250 degrees Celsius.

EVOLUTION THROUGH COLOR SPACE

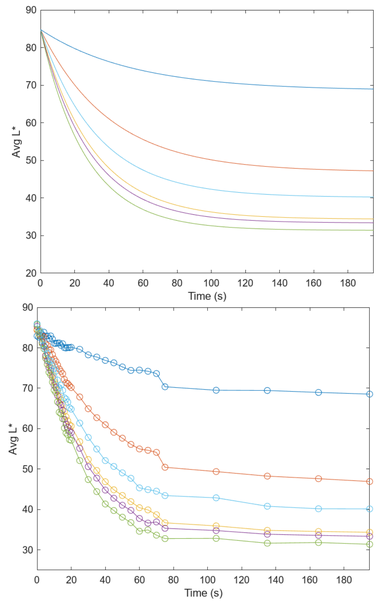
An extremely common way to represent colors in scientific literature is the CIELAB color space developed in 1976. This color space splits colors into their brightness (L*), green versus red (a*), and blue versus yellow (b*).



This however results in a spiral for this both UV and heat stimuli, whereas in experiments with other stimuli the path taken was linear, so the traditional Euclidean distance used is no longer effective for modeling stimulus. So our goal is to fine an effective method for predicting sensors response dependent on concentration.

CONCENTRATION BEHAVIOR

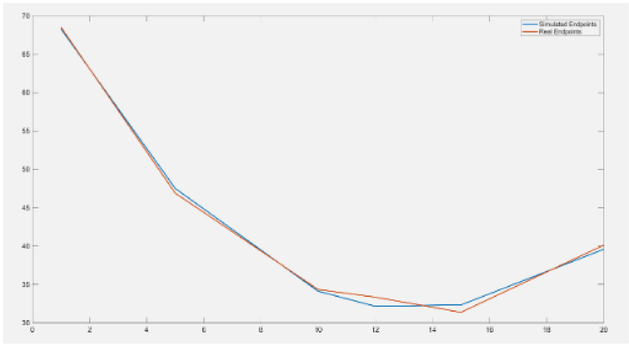
We were able to successfully predict sensor response to UV by selecting a single color channel from the CIELAB color space which had monotonic behavior. Then, we were able to see how these models of sensor response change with the concentration of PDA used, which revealed as expected an optimal valley for sensitivity to UV exposure (figure in next section). This gives us insight into the behavior of the sensor under heat disrupting conjugation.



MORE RECENT AND FUTURE WORK

More recently, we've begun to similarly model how the sensor responds to heat, revealing similar behavior with more differences in the extremes, We'd then like the take a similar path of seeing how these models vary with both sensor concentration and UV time prior to heating, giving us a deeper understanding of sensor response and allowing us to predict sensor behavior with much wasted material in the lab.

This will ideally allow us to tune the sensors to specific stimuli ranges, as well as give us more insight for how sensors doped with metals that respond to other stimuli might respond, Further, this work provides a work flow in the case that the response observed does not fit the traditional models of progression used.



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