Multifunctional Biomimetic Nanocoatings: from an Intact Thin Film to Microcracks to Wrinkles and the Corresponding Property Tuning

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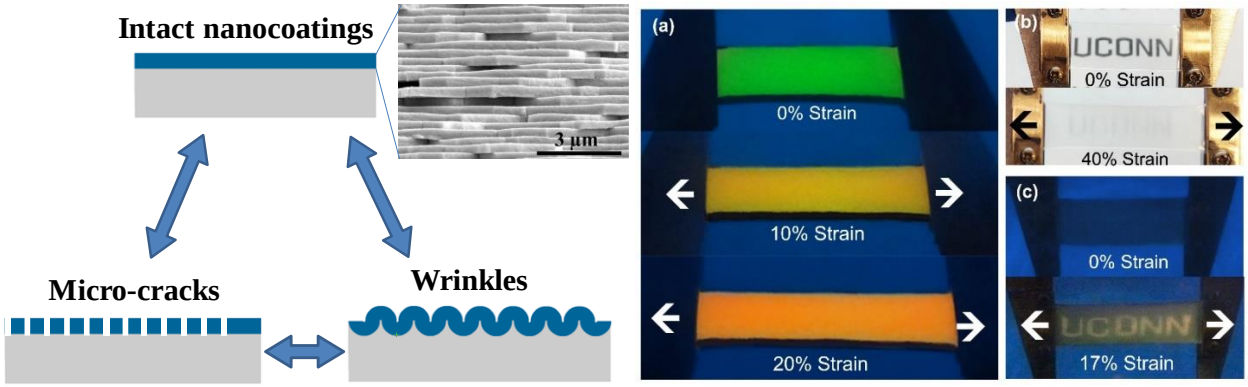
Abstract

In this presentation, nanocoatings with three distinct microstructures inspired by nature will be discussed. In the first part, organic/inorganic hybrid nanocoatings with a nacre-like microstructure generated via a facile co-assembly process will be presented. Thanks to the high concentration (up to 70 wt%) of well-aligned inorganic nanosheets and a well-integrated structure after crosslinking, such thin coatings exhibit exceptional mechanical, barrier, and flame retardant properties, while maintaining a high transparency. In the second part, inspired by marine organisms that can use muscle-controlled surface structures to achieve rapid and reversible changes in transparency, color, and patterns, a series of strain dependent mechanochromic devices will be presented. Utilizing microcracks generated via deformation-controlled surface-engineering, rigid nanocoatings affixed atop a soft substrate exhibit a broad range of mechanochromic behaviors with high sensitivity and reversibility. In the third part, a series of moisture responsive wrinkle dynamics inspired by human skin on a similar bilayer structure featuring different reversibility and stability will be discussed. These unique responsive dynamics result in the invention of a series of optical devices triggered by moisture, including anti-counterfeit tabs, encryption devices, water indicators, light diffusors, and anti-glare films. The above three biomimetic nanocoatings are promising for widespread applications.



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