DNA-based Materials and Their Applications

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Biography:

Dr. Dan Luo is currently Professor in the Department of Biological and Environmental Engineering at Cornell University. Dr. Luo obtained his B.S. from the University of Science and Technology of China and his Ph.D. from The Ohio State University in 1997. He carried out his postdoctoral training in the Department of Chemical Engineering at Cornell under Prof. Mark Saltzman. Dr. Luo joined Cornell faculty in 2001 and was promoted to full professorship in 2011. He is a recipient of the National Science Foundation's CAREER Award, the Cornell Provost's Award for Distinguished Scholarship, the SUNY (New York State) Chancellor's Award for Excellence in Scholarship and Creative Activities, the Journal of Materials Chemistry Editorial Board Award, New York State Faculty Development Award ("Distinguished Professor"), College Award for Outstanding Accomplishments in Basic Research, and Bill and Melinda Gates Foundation Point-of-Care Diagnostics Grand Challenge Award. He was also selected four times by top undergraduate students as a Cornell outstanding educator. Dr. Luo was elected as a College Fellow of the American Institute of Medical and Biological Engineering (AIMBE) in 2013, and was awarded the National QianRen title (Innovation, B) by the Chinese government in 2014.

Abstract：

Over the last 15 years, my group at Cornell has been engineering DNA as both genetic (bio-) materials and generic (nano-) materials. In this talk, I will focus on how we have designed DNA as polymers in order to develop bulk-scale, DNA-based biomaterials for real-world applications. More specifically, I will elaborate on our branched DNA and DNA-based hydrogels - they are DNA molecules with specially designed sequences for enzymes. Also they are either covalently or non-covalently connected (or entangled), all in a bulk scale. We have demonstrated a number of real-world applications from diagnostics to pharmaceutics. For example, branched DNA was used as nanoscale barcodes for the detection of pathogen DNA. Proteins were efficiently expressed from the DNA hydrogel in a cell-free fashion. In addition, by creating a DNA-based hydrogel made from ancient clay minerals and sea water, we showed that nucleic acids were immobilized on the clay hydrogel and were protected against nuclease, and that transcription and translation reactions were persistently enhanced. We have used DNA-clay interaction to realize large scale protein production. Our DNA-clay hydrogel also implicates that biochemical reactions during the early life evolution may have happened in a similar clay-DNA hydrogel environment. DNA have proven to be not only the amazing molecule of life, but also a powerful and versatile molecule for biomaterials.

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