

# **BUILDING PLASMONIC NANOARCHITECTURES WITH DNA**

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Plasmon resonance refers to the collective oscillation of conduction band electrons in a metal, which can be induced by an electromagnetic wave (light). Unlike a bulk metal of infinite size or an extended metal surface where plasmons propagate, a metal nanoparticle confines plasmons within a finite volume. Thus, nanoparticles-supported plasmons are localized and non-propagating, which behave as nanoscale light concentrators. Plasmonic nanoparticles can serve as key components in future miniaturized all-optical computing nanocircuits due to their capability of confining light at the nanoscale circumventing the diffraction limit. In addition to nanophotonic applications, plasmonic nanoparticles are also being applied in sensing, energy-harvesting and photothermal therapy. Progress in the experimental nanotechnologies in the past two decades, which is in conjunction with various theoretical modeling strategies, has greatly deepened our understanding of plasmonic properties of metallic nanostructures, leading to the birth of a flourishing new field of science and technology – nanoparticle plasmonics.

A central goal in nanoparticle plasmonics is to create well-defined plasmonic nanoparticles and to rationally control their assembly in order to precisely manipulate light-matter interactions at the nanoscale without restriction of diffraction limit. Recently, significant progress has been achieved in wet chemical synthesis of single crystalline plasmonic nanoparticles in large amount. However, it remains a great challenge to organize these plasmonic nanoparticles into well-defined architectures for real-world, cost-efficient, nanoparticle-based devices for new-generation nanoenergy-harvesting systems, smart adaptive optoelectronics, intelligent drug-delivery, etc.

In this talk, I will discuss our recent success in fabricating periodic plasmonic nanoparticle arrays (superlattices) by using DNA as a soft handle. We used branched DNA to develop a general modular approach for programming the assembly of multifunctional architectures. By coupling conventional DNA-based approach with a drying-mediated self-assembly process, we obtained large-area, high-quality nanoparticle superlattices stable in the dried state. Furthermore, we developed a simple yet efficient method for patterning these superlattices. Using this method, we were able to shape superlattices into versatile nanoscale features by means of micrometer-sized plastic moulds. In conjunction with a microhole-confinement, we have also created free-standing superlattice sheets in their ultimate thickness limit. In addition, I will

discuss the unusual soft crystallization dynamics of DNA-capped nanoparticles by virtue of real-time and in-situ synchrotron-based small-angle X-ray scattering. Our results have revealed a theoretical model that can be applied in general for static and dynamic self-assembly of organically-capped nanoparticles.

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### **Biography**

Wenlong Cheng is an associate professor in the Department of Chemical Engineering at Monash University, Australia. He earned his PhD from Chinese Academy of Sciences in 2004 and his BS from Jilin University, China. He held positions at the Max Planck Institute of Microstructure Physics and the Department of Biological and Environmental Engineering of Cornell University before joining the Monash University in 2010. His research interest lies at the Nano-Bio Interface, particularly addressing plasmonic nanomaterials, DNA nanotechnology and electrochemical nanocatalysts. He has published 28 journal papers with over 720 citations and a H-index of 17. He has also coauthored 3 book chapters and 2 US patents.