3D active plasmonic nanomaterials

Na Liu
Max Planck Institute for Intelligent Systems, Heisenbergstrasse 3, D-70569 Stuttgart, Germany
Tel. +49 711 689-1838, laura.liu@is.mpg.de

Construction of 3D reconfigurable plasmonic nanostructures witnesses major technological limitations, arising from the required subwavelength dimensions and controlled 3D motion. There have been considerable efforts on integration of plasmonic nanostructures with active platforms using top-down techniques. Here we lay out and implement a multi-disciplinary strategy to create active 3D plasmonic nanostructures by merging plasmonics and DNA nanotechnology on the nanoscale.

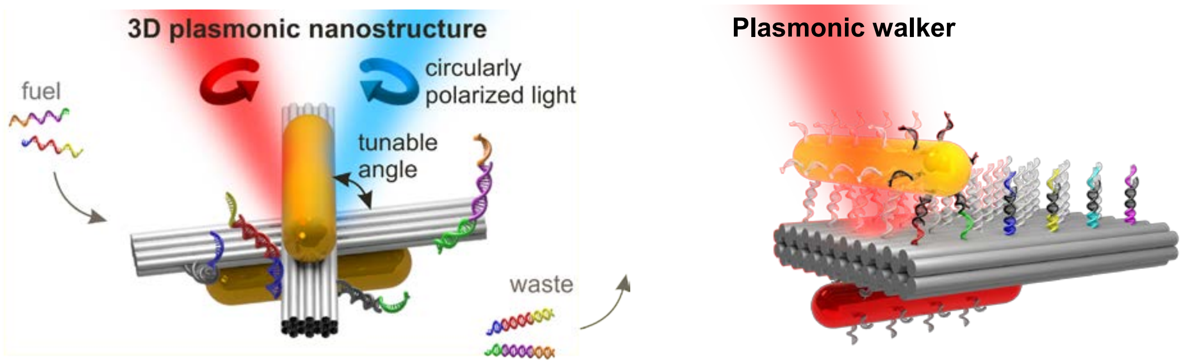

Figure 1: 3D reconfigurable plasmonic switch (left) and plasmonic walker (right).

First, we show the creation of a reconfigurable plasmonic switch (Fig. 1, left), which can execute DNA-regulated conformational changes. In one role, DNA works as molecular platform for organizing plasmonic nanoparticles into a 3D architecture. In the other role, DNA is used as fuel to drive the constructed 3D plasmonic switch along fully programmable routes. Simultaneously, the 3D plasmonic switch serves as optical reporter, which transduces its own conformational information into optical circular dichroism changes upon external stimuli in real time.

Next, we demonstrate the first plasmonic walker (Fig. 1, right), which can carry out directional, progressive, and reverse nanoscale walking on a DNA origami track. The plasmonic walker comprises an anisotropic gold nanorod as its 'body' and discrete DNA strands as its 'feet'. Specifically, our plasmonic walker carries optical information and can *in situ* optically report its own walking directions and consecutive steps at nanometer accuracy, through dynamic coupling to a plasmonic stator immobilized along its walking track. The dynamic process can be read out using circular dichroism spectroscopy at visible frequencies in real time.

Our concept may enable a variety of smart nanophotonic platforms for studying dynamic light-matter interaction, which requires controlled motion at the nanoscale well below the optical diffraction limit.