Fabrication and characterization of gold nano-gaps for ssDNA immobilization and hybridization detection

Abstract

We develop a method for fabricating the nano-gaps directly by using just photolithography and wet etching processes without any nano lithography or difficult techniques. It shows that this resolution enhancement allows one to fabricate metal electrodes with separation from arbitrarily large to fewer than one hundred nanometers. Furthermore, because these nano-gaps are on a thin film, they can be imaged with high-resolution transmission electron microscopy (HRTEM). Efforts toward achieving electrical contact to nanostructures have been active for over a decade. Even though several devices based on "nano-gaps" - two gaps separated by a nanometer-scale distance - have been demonstrated, their realization has remained a significant challenge. Even the best methods are highly labor-intensive and suffer from low yield and poor geometrical control. Most nano-gaps are also incompatible with high resolution transmission electron microscopy (HRTEM) and scanning electron microscopy (SEM). As a consequence, the proof of the nano-gap quality and content in past studies has been indirect. High-resolution imaging is therefore required to ensure the quality of nano-gaps and to be able to identify possible artifacts. This project presents a unique vertical nano-gap biosensor that can detect changes in DNA structure. Using a size reduction to interrogate samples between the nano-scale gaps, this biosensor will be sensitive enough to record the conformational changes for ss-DNA.