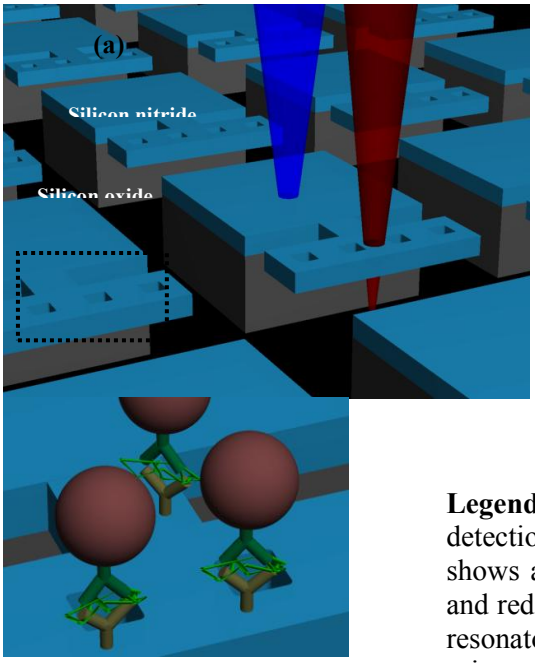
SCIENTIFIC ACCOMPLISHMENTS: NANOSCALE DEVICES AND SYSTEMS (PCA 3)

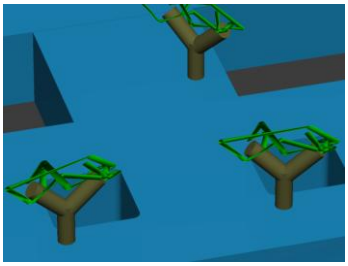
SELF-AMPLIFYING NANOBIOSENSOR FOR DIRECT DETECTION OF PRIONS IN BLOOD

Prion proteins are responsible for progressive neurodegenerative diseases in many species. In cows the disease is referred to as bovine spongiform encephalopathy (BSE) or "mad cow" disease. Currently, the only means to detect the prion proteins in diseased cows is to remove their brains at slaughter and perform laborious and time-consuming analysis of the brain tissue. Since potentially infected cows that do not show symptoms would not be routinely tested for "mad cow" disease, it would be advantageous to develop a means to detect prion proteins in the blood of *all* cows prior to slaughter. Furthermore, since creutzfeldt-jakob disease (CJD) in humans has been linked to both the consumption of contaminated beef and blood transfusions, the safety of the human food supply would be dramatically improved by a rapid and sensitive test that could detect prions in the blood circulation of all cows prior to slaughter. Drs. Richard Montagna and Herald Craighead have developed a nanodevice known as a resonating cantilever (similar to a miniature diving board). The cantilever resonates or vibrates at a unique frequency and as particles bind to its surface, its resonant frequency decreases in a measurable manner. We have developed a means to capture prion proteins on the surface of the resonating cantilevers and have successfully detected prion proteins in bovine serum at a minimum concentration of 200 picograms/mL. Continued efforts are currently underway to further improve this detection limit.



(b)

(c)



(d)

Legend: Schematic diagrams of mechanism of actuation and detection of resonant frequencies and secondary mass labeling. (a) shows an array of bare resonators actuated and detected by blue and red laser, respectively. Dotted rectangle shows the area of the resonator shown in figures b and c; (b) shows the conjugation of prion protein on the surface using capture antibodies; (c) shows the secondary mass labeling with nanoparticles. Detection antibodies were used in between nanoparticles and prion protein; and (d) shows the change in resonant frequencies with mass addition. Antibodies, prion proteins and nanoparticles are represented by Y-shape, intertwined ribbon, and spheres, respectively. Diagram is not drawn to scale.