

Detecting a Biological Attack

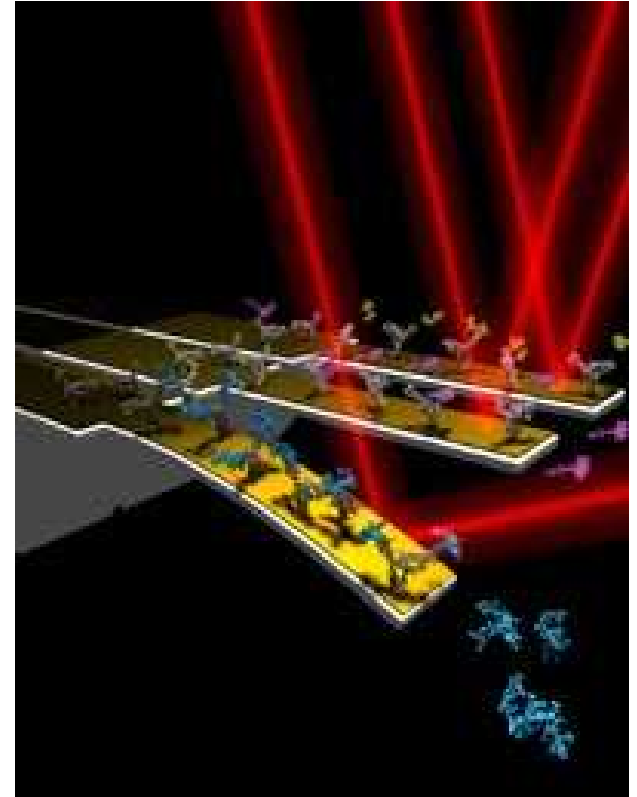
- The attack will not be obvious; it may take hours or days to know.
- Current biological diagnostics are very effective at identifying agents, but they're slow.
- We already have an infrastructure in place: the US healthcare system.
- A successful attack could make enough sick people to overwhelm the infrastructure; fast response is essential.



Can we detect biological agents quickly, inexpensively, and effectively?

A Micro-Cantilever for Biological Detection

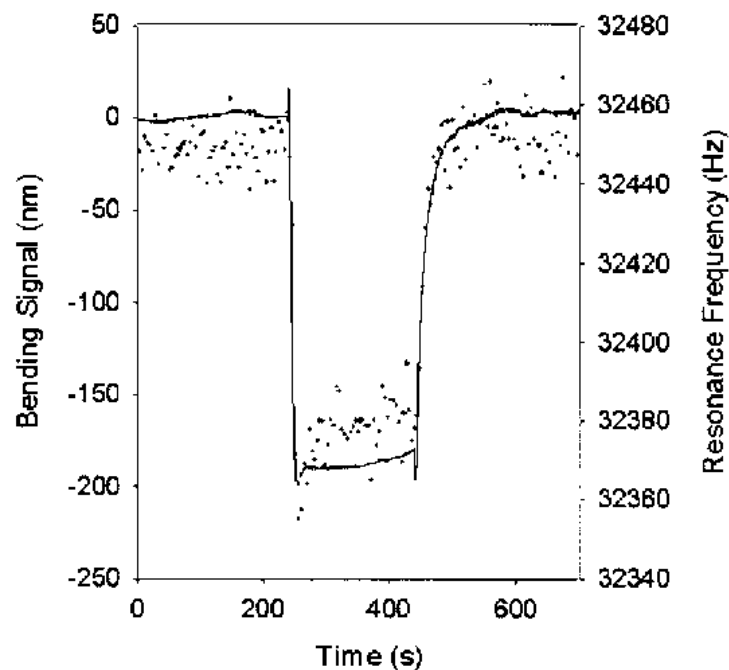
- Fabricate a diving-board-shaped cantilever $50 \times 200 \mu m$ using standard microchip manufacturing methods.
- Coat the top with antibodies for protein markers of specific diseases.
- Targeted proteins bind to the cantilever causing it to bend; more proteins then more bending.
- Detect the bending with a laser or other method.



A fast, inexpensive, sensitive biosensor!

Does It Work in the Laboratory?

- For PSA or prostate-specific antigen (a protein marker of prostate cancer which is the number two killer of men in the US) the technique is sensitive to 20 times below the clinically relevant threshold.
- Plastic explosives have been detected at the level of 10 ppt within 20 seconds of exposure.⁵
- E. Coli bacteria (major cause of food-borne illness) has been detected at 10^6 cfu/mL with microcantilevers.⁶



⁵ L.A.Pinnaduwa, *et al.*, Appl. Phys. Lett., 83, no. 7, (2003).

⁶ J.Zhang and H.F.Ji, Analyt. Sci., 20, 585 (2004).

Does It Work in the Field?

- IR sensors have been developed that are cheaper than older alternatives by a factor of 25.
- The PSA technology has already been transferred to the private sector via a Cooperative Research and Development Agreement (CRADA) between Oak Ridge National Laboratory and several companies.
- The Microelektronik Centret (MIC) in Denmark (<http://www.nanotech.dtu.dk/English.aspx>) is an academic research facility with 11 industrial collaborations including using microcantilevers for biodetection.
- Lots of activity in the research community for biodetection.
- Some companies are building or developing chemical or biosensors, but most of the companies are using microcantilevers for other purposes.

Are There Customers/Users/Victims?

- Some say 'GO!'.
 1. The \$700 billion/year healthcare industry.
 2. Homeland security agencies (federal to local) may use them.
 3. Synergistic relationship with manufacturing, *i.e.* improvements in chip manufacturing can improve the microcantilevers.
 4. Other challenges (*i.e.*, landmine detection) add incentives.
- Some say 'MAYBE!'.
 1. It's expensive; about \$100 million to develop medical diagnostic tests.
 2. Drug companies may not want them; genetic tests could identify patients that will not benefit from the company's drugs and reduce sales.

“most interesting marketing question of the next decade”

*Samuel Colella,
Versant Ventures*