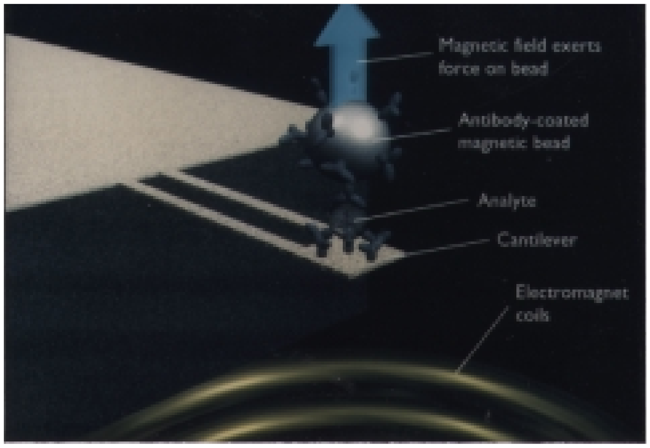
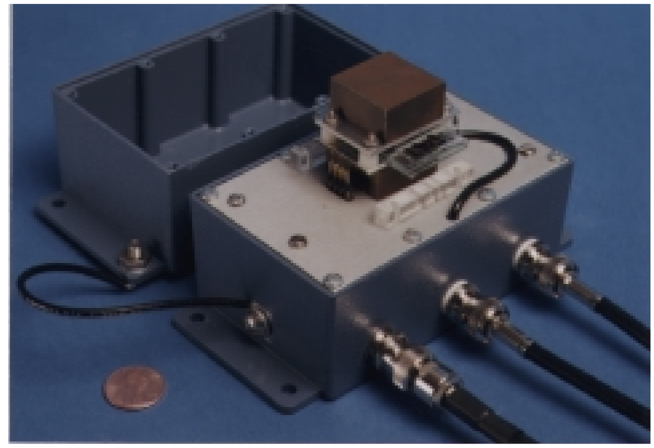
SINGLE-MOLECULE DETECTOR



FABS concept (not to scale). A cantilever-beam force transducer senses magnetic beads, the number of which is proportional to the concentration of analyte in the sample.



Overall view of the first prototype FABS device showing the magnetic assembly and preamplifier. At present the power supplies and lock-in amplifier are external.

The Naval Research Laboratory is developing an ultra-sensitive sensor based on force microscope technology. The sensor will be capable of detecting a wide variety of biologically-active materials including proteins, toxins, cells, and viruses in concentrations as low as 10^{-18} M (approaching a single particle per 10-100 ml sample volume). The projected chemical sensitivity exceeds competitive techniques such as ELISA, solid-phase radioimmunoassay, and evanescent-wave fiber optic biosensors by 6-8 orders of magnitude.

The "force amplified biological sensor" (FABS) will take advantage of the high sensitivity of force microscope cantilevers (a micromachined force transducer; see diagram above) to detect magnetic particles bound to the cantilever using an immunoassay. This technique will offer a number of significant advantages:

- ***versatility:*** can use sandwich, competitive, and displacement immunobead assays
- ***sensitivity:*** ability to detect a single bound molecule greatly reduces sampling requirements
- ***speed:*** no washing or amplification steps required; projected assay time is 10 minutes
- ***automation:*** a microcontroller can run the entire assay without human intervention
- ***portability:*** device will be miniature and rugged with low power requirements
- ***potential:*** possibilities include measuring antibody-antigen binding forces and using micromachining technology to create multiple-analyte sensor arrays.

Potential applications include health care, process monitoring, quality control, and environmental monitoring.

Points of Contact
Naval Research Laboratory
4555 Overlook Avenue, SW • Washington, DC 20375-5320

Jane F. Kuhl • Head, Technology Transfer Office • (202) 767-3083 • kuhl@utopia.nrl.navy.mil
Richard J. Colton • Chemistry Division • (202) 767-0801