

# Microcantilever Gas Analyzer for Detecting Resonances (05-015, 09-039)

Simple and Portable Resonant Frequency Detector

## Market Overview

This resonance frequency detector is capable of detecting a wide variety of parameters affecting resonance through the use of a patented micro-cantilever. This detector modulates electric charge at varying frequencies on a counter electrode until it matches the induced frequency on a cantilever. Current resonance detection devices require piezoelectric or chemically functioned cantilevers or lasers. However these methods require multiple components, are bulky, or have parasitic capacitance. Clemson University researchers have developed a method to detect chemical/biological species and measure parameters such as pressure and acceleration, magnetic force, temperature, and extremely small balances by observing the resonance changes between the cantilever and an electrode. This approach provides an electrical alternative with a simple handheld design, allowing for portability and addressing unmet needs of the market.

## Technical Summary

This detector identifies and analyzes electrical signal in semi-conductive or conductive elements at resonance frequencies. The detection and analysis of an electric signal is performed based on movement between an element and a counter electrode influenced by a non-linear electric field produced by an electrical signal impressed between the element and counter electrode. Changes in the distance and environmental parameters between the element and counter electrode. Changes in the distance and environmental parameters between the element and the counter electrode may be monitored based on the changes in the value of the capacitance between the element and counter electrode. The method includes applying a signal to a counter electrode and thereby inducing an electrostatic force on a cantilever that is in a non-contact arrangement with electrode. This electrostatic force generates electric signal at the element. At resonance, this generated signal will contain not only the fundamental mode of the applied signal, but will also contain harmonics of the generated signal. By observing the changes in the generated signal, chemical/biological species can be detected as well as monitor parameters that influence resonance.

### Application

Detection of chemical/biological species

### Development Stage

Working Prototype

### Advantages

- Lower cost, operates without lasers or special cantilevers used in current systems
- Easy manipulation of resonance, creating a wide range of measurement possibilities
- Simple recognition of micro/nano-sized chemical/biological species, allowing for portable detection in hand-held form

| App Type | Country       | Serial No. | Patent No. | CURF Ref. No. | Inventors  |
|----------|---------------|------------|------------|---------------|--|
| Utility  | United States | 12/573,433 | 8,384,372  | 2005-015      | Dr. Apparao Rao<br>Malcom Skove<br>Doyl Dickel<br>Gayatri Kesar<br>Bevan Elliot<br>Herbert Behlow Jr |
|          |               |            | 7,598,723  | 2009-039      |  |

## About the Inventor



### Dr. Apparao Rao

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Dr. Apparao Rao received his Ph.D. in condensed Matter Physics from the University of Kentucky. Prior to joining Clemson he held a Post-doctoral Research Associate position at the MIT and was an Assistant Research Professor at the University of Kentucky. He is the founder of the Clemson Nanomaterials Center and has received the South Carolina Governor's Award for Outstanding Achievement in Research. His research interests include the characterization and applications of carbon nanotubes, semiconducting nanobelts, nanowires and thermoelectric materials.

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