A Microfabricated Gas Analysis System

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Goal: to create an integrated microsystem consisting of a gas plasma and a microspectrometer that is capable of detecting air-borne contaminants with a detection limit of approx. 1 ppm.

MEMS Plasma Generator
A low power, electrodeless plasma source on a chip

Applications:
- Chemical analysis: optical and mass spectroscopy
- Low temp. sterilization of BioMEMS devices
- Array-addressable materials processing
- Microthrusters for miniature space craft

Operation:
- Electrodeless inductive coupling allows use with chemically reactive gases
- Low power (300 mW - 3 W), low voltage (< 20 V)
- Gas pressure: 0.1 - 10 Torr (13 - 1300 Pa)
- Argon ion density: $10^{10} - 10^{11}$ cm$^{-3}$
- Electron temperature: 20,000 - 50,000 K
- Non-equilibrium plasma allows operation near room temperature, however.

Challenges: Optimize photon generation (plasma) and collection (optics)
- Increase resolution of the FPI (mirror reflectivity, position)
- Address system integration and parasitic interactions

Experimental Performance of the Micro FPI with Aluminum Mirrors

Applications:
- Analytical Emission Spectroscopy
- Colorimetry
- Optical filtering/communications

Operation:
- Free spectral range covers visible spectrum in the first order
- Higher resolving power by using higher orders
- Electrostatic actuation voltage: 20-100 volts
- Capacitive sense electrodes used to determine mirror position and wavelength
- Separately fabricated and assembled mirrors allow high reflectivity

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