

Analytical Seminar

Thursday, Sept. 15, '16

12:15 p.m. in room 1315

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Sensing with waveguides: Absorption, refractive index and strain measurements using fiber probes

Fiber optic devices are increasingly used in structural health monitoring, but also have many uses in chemical sensing. In the past decade we used fiber-optic devices for measurements of optical absorption, fluorescence refractive index, pressure, and strain.

I will briefly describe several different devices:

- An optical cavity embedded into a telecom-grade optical fiber is very sensitive to strain and temperature. The quality of the transducer is demonstrated by using the system as a pickup for musical instruments, i.e. for recording sound distortion free and with a high frequency bandwidth. In a series of experiments we demonstrated that the "Photonic Guitar" pickup has a superior frequency response and far-superior signal-to-noise ratio over existing pick-up technology.
- Photoacoustic spectroscopy can be conducted using similar fiber cavities as strain sensing elements. These instruments are capable for detecting small changes in analyte concentration through the absorption of intensity-modulated laser light.
- Miniaturized silicon-photonic cavities are of great use as sensors for refractive index changes. Using, e.g. waveguide ring-cavities made from silicon nanowires we can detect heavy metals and inorganic ions from the subtle changes in refractive index that they induce in appropriately functionalized coatings.
- Macroscopic ring-cavities made from loops of regular fiber optic cables also act as surprisingly versatile detectors for optical absorption. We introduce a small liquid sample into a gap in this fiber optic loop and perform ring-down spectroscopy to detect analytes at low concentrations in sample volumes below a microliter.