

# LOW-COST OPTICAL SENSORS FOR HIGH PERFORMANCE, DISCRETE HEARING AIDS

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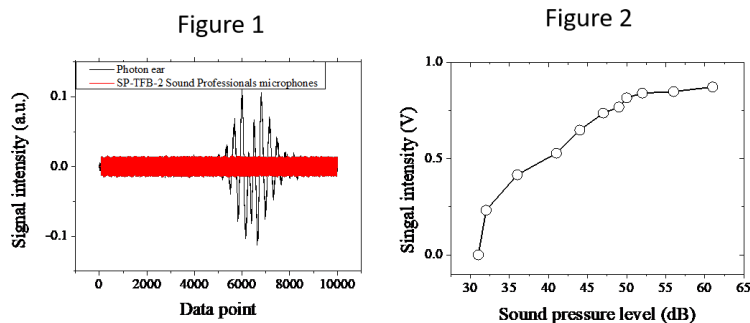
## Technology Description

A team of engineers in Prof. Lan Yang's laboratory have developed ultra-sensitive, broad bandwidth optical sensors that could detect sound in low-cost, discrete hearing devices. This technology utilizes whispering gallery mode (WGM) resonators as compact photonic vibration sensors with the potential to produce better audio quality with vivid details.

Currently, most hearing aids capture external sound with microphones that have limited sensitivity and bandwidth, making it difficult to distinguish speech in noisy places. In addition, these conventional devices require an external element that causes discomfort and can't be used during certain activities. To solve these problems, this technology replaces conventional microphones with WGM resonators - high quality, micro-scale optical devices that use light to trigger sound waves, resulting in ultra-sensitive, multi-pass sensors. These robust, low-cost WGM sensors detect sound across the full spectrum of hearing with improved signal to noise compared to standard microphones. Furthermore, the sensors can be easily integrated into existing devices and discretely worn without an uncomfortable external element.

## Stage of Research

The inventors have built a packaged WGM sensor and compared it to a conventional microphone using recorded audio. They validated the sensor performance, detecting noise at 36 dB (below ambient noises) with a wide dynamic range of 30 dB (quiet ambient noise) to 65 dB (conversation in a public place). The inventors are developing different WGM geometries to improve performance.



**Figure 1:** WGM resonator sensor (black) detects signal at intensities that a conventional microphone (red) does not. **Figure 2:** Extended dynamic range of WGM resonator (30 dB – 65 dB).

## Applications

- Hearing aid sensor

## Key Advantages

**High performance sensor** with potential to produce better audio quality with vivid details

- ultra-sensitive optical WGM sensor detects soft sounds that are undetectable with conventional microphones
- broad detection bandwidth covers the whole spectrum of hearing
- techniques adapted from semiconductor industry improve signal-to-noise ratio
- may overcome the 10 kHz-20kHz “roll off” for compact microphones

**Compact and discrete** – small sensor footprint with no external element

- easily integrated into existing devices
- more comfortable than traditional hearing aids and can be used during physical activities

**Low manufacturing costs** – scalable, inexpensive fabrication with target cost of less than \$1/sensor

**Patents:** Application pending

**Related Web Links:** [Yang Lab](#)