A Photoacoustic Needle Imaging Probe for In Vivo Biopsy

TECHNOLOGY NUMBER: 2025-351

OVERVIEW

Needle imaging probe for real-time, non-scanning photoacoustic tissue tomography.

- Enables rapid, volumetric imaging without pixel scanning; reduces invasive biopsy extractions
- Real world applications: Pathology assessment, disease localization, prostate and organ imaging, biopsy guidance, minimally invasive diagnostics

BACKGROUND

Traditional diagnosis of tissue pathology, such as in prostate cancer, relies heavily on core needle biopsies, where small tissue samples are physically extracted and examined histologically. While effective, this method is invasive, can be painful, and often requires multiple insertions, increasing patient discomfort and risk of complications. Furthermore, the approach samples only limited regions, which may miss clinically significant disease and fail to provide volumetric information about the surrounding tissue architecture. Existing imaging techniques, like photoacoustic microscopy, require time-consuming pixel-by-pixel scanning and are difficult to integrate with needles for in situ assessment. As the demand for less invasive, more comprehensive diagnostic tools grows, there is a clear need for a technology that can enable real-time, volumetric tissue characterization with minimal disruption and fewer needle passes.

INNOVATION

This invention is a needle-compatible imaging probe that utilizes photoacoustic tomography enhanced by a micro-ring resonator array. Unlike conventional photoacoustic microscopy, the probe acquires full volumetric images instantly, without requiring pixel-by-pixel scanning. Designed to match the dimensions of an 18G core biopsy needle, it can be inserted directly into tissue, such as the prostate, to map pathology over a larger volume than a single biopsy core. This capability enables clinicians to assess both the location and pathology of disease with just a few needle insertions, dramatically reducing the need for multiple extractions. The probe provides real-time, high-resolution diagnostic imaging, supporting faster, more accurate, and less invasive biopsies. Potential real world applications include guiding tissue biopsies, diagnosing tumors, monitoring disease progression, and improving outcomes in minimally invasive clinical procedures for a range of organ systems.

Technology ID
2025-351

Category
Medical Devices
Life Sciences

Inventor
Hyeonwoo Kim
Wei-Kuan Lin
Linyu Ni
Xueding Wang
Jay L. Guo
Matthew Davenport
Aaron Udager
Todd Morgan
Chandy Ellimoottil
John Wei
Guan Xu

Further information
Katherine Pollard
kpollar@umich.edu

View online page