QUADRATIC ELECTRO-OPTIC BASED DEFLECTION-FREE WIDE PATH-LENGTH MODULATION AND LATERAL SCANNING DEVICE FOR TIME DOMAIN OPTICAL COHERENCE TOMOGRAPHY

IITM Technology Available for Licensing

Problem Statement

- Conventional systems involving FDOCT, Spectral Domain OCT (SDOCT) and Swept Source OCT (SSOCT), offers rapid axial scanning capabilities without mechanical components.
- However, it presents challenges such as **substantial data processing** requirements and the need for **high-resolution spectrometers** and line-scan cameras **for imaging deep tissues,** making the detection system **bulky and complex**

Technology Category/ Market

Category– Medical and Surgical/ Non Destructive Testing
Applications –Test Equipments, NDE, Biomedical systems, Sensors, Medical imaging
Industry- Biomedical Engineering, **Healthcare**
Market -The global medical imaging market size was valued at **USD 32.3 billion in 2022** and is expected to grow at a compound annual growth **rate (CAGR) of 4.8% from 2023 to 2030.**

Key Features / Value Proposition

Technical Perspective:

- **A high speed axial and lateral scanning device** for time domain optical coherence(TCOCT) system that enables **non-mechanical noiseless imaging**
- **Interferometric imaging** provides **highly sensitive and can reveal fine details and subtle changes in the sample**, also allows for precise measurement of optical path differences and variations
- Involves **less data processing** and **does not have constraints on depth imaging .**
- **Polarized Imaging** uses **polarizers and quarter-wave plates** to manipulate the polarization state of the light beam that can reveal information about the sample's optical properties and anisotropy

User Perspective:

- Versatile technique and can be used for both biological samples that include **tissue analysis or cellular imaging as well as non-biological samples.**
- Offers **a range of imaging modalities**, making them valuable tools for scientific research, medical diagnostics, and materials characterization

Technology

- The present invention discloses electro-optic systems capable of performing axial, lateral, multi-dimensional, and even three-dimensional imaging
- The said electro-optic system for axial scanning of a sample comprising of:

A light source producing a light beam

A **detector** and an interferometer connected to the light source, where **Interferometer** includes a polarizer

A **beam splitter** that divides the light beam into two beams.

Sample defining a **sample arm.**

Electro-optic crystal maintained at a fixed temperature and linked to a **voltage source within the reference arm**

At least one **electro-optic crystal** is maintained at a predetermined temperature within the sample arm.

- Involves utilization of two sets of electro-optic crystals, where each set is maintained at two predetermined temperatures.
- The sample used is electro-optic crystal (6) is KTN crystal of the formula $KTa_{1-x}Nb_xO_3$

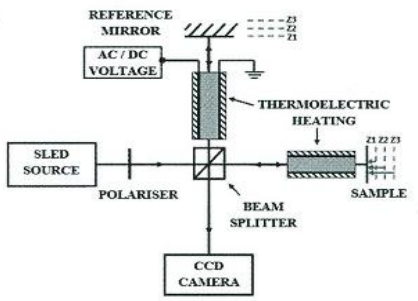

Fig.1 is the schematic representation of quadratic electro-optic based path-length modulation.

CONTACT US
Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719

Different types of imaging of imaging can be performed with the described electro-optic systems, include :

❖ **Axial Scanning Imaging:**

Allows for imaging along the axial (depth) direction of the sample and provides insights into the internal structure and composition of the sample.

❖ **Lateral Scanning Imaging:**

Enables imaging in two dimensions, typically the x and y axes useful for capturing cross-sectional or planar views of the sample's surface or structure.

❖ ***Multi-Dimensional Imaging:***

Combines axial and lateral scanning, allowing for 3D imaging and provides a comprehensive view of the sample in terms of depth and lateral dimensions.

Images

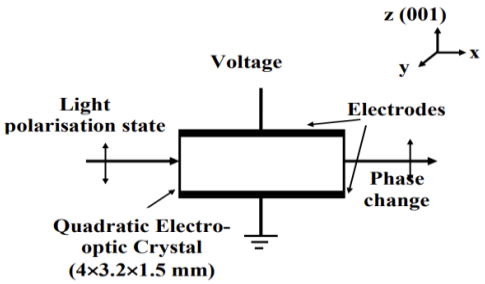

Fig.2 is the image of orientation and electro-optic phase tuning in KTN.

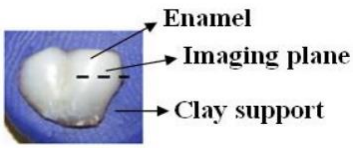

Fig.3(a) is the image of demineralised tooth sample

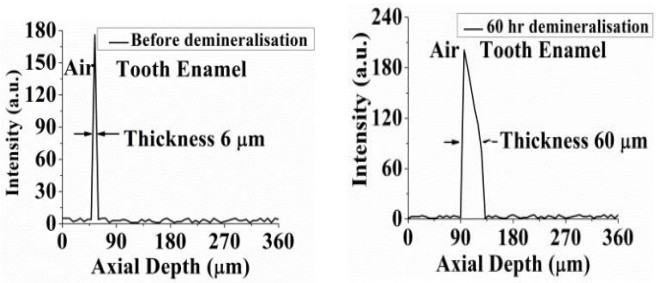

Fig.3(b) and 3(c) are images of demineralised tooth sample before mineralization and after 60hr demineralization B scans

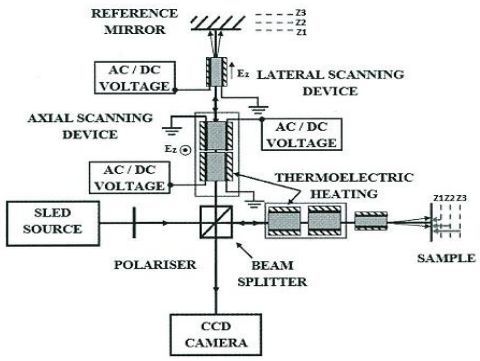

Fig 4. Lateral screening and path length modulation in motionless two dimensional imaging

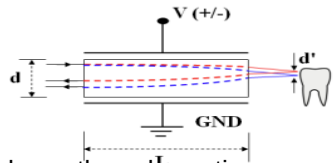

Fig.5 shows the schematic representation of electrooptically tuned lateral scanning

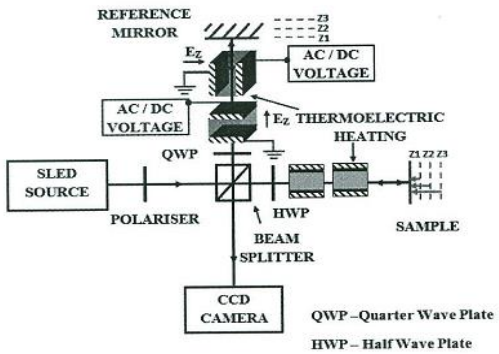

Fig.6 STD-OCT with quadratic electro-optic axial scanning

Intellectual Property

- **IITM IDF Ref. 1448**
- **IN380174-Granted**

TRL (Technology Readiness Level)

TRL-4, Technology Validated in the Lab

Research Lab

Prof. Nilesh Jayantilal Vasa
Department of Engineering Design
Prof. Sarathi R
Department of Electrical Engineering

CONTACT US
Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719