IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

Two-Dimensional (2D)Material based Fluorescent Optical Fiber Sensor for Partial Discharge Detection in Transformers and Methods

IITM Technology Available for Licensing

Problem Statement

- Existing partial discharge (PD) detection systems based on fluorescent optical fibers have limited sensitivity, particularly for low-magnitude discharges and early detection.
- **Need for Enhanced Efficiency and Sensitivity**: There is a lack of prior art addressing the enhancement of efficiency and sensitivity in PD detection systems using fluorescent optical fibers.
- **Potential Solution:** The introduction of a thin layer of 2D materials as a coating on fluorescent fiber optics could potentially improve the efficiency and sensitivity of PD detection systems.

Intellectual Property

- IITM IDF Ref. **2531**
- **IN 538500 - Patent Granted**

TRL (Technology Readiness Level)

TRL - 4: Technology validated in lab scale.

Technology Category/ Market

Category - Power Systems
Applications- Transformer Condition Monitoring, High Voltage Power Systems, Electrical Equipment Manufacturing
Industry- Energy, Power Generation, Industrial Automation, Electrical Equipment Manufacturing

Market - Partial Discharge Monitoring Systems market is expected to reach USD 827.2 Billion by 2030, with a **CAGR of 5.4%** from 2024 to 2030.

Research Lab

Prof. Shivananju Bannur Nanjunda,
Prof. R. Sarathi,
Prof. Balaji Srinivasan
Dept. of Electrical Engineering

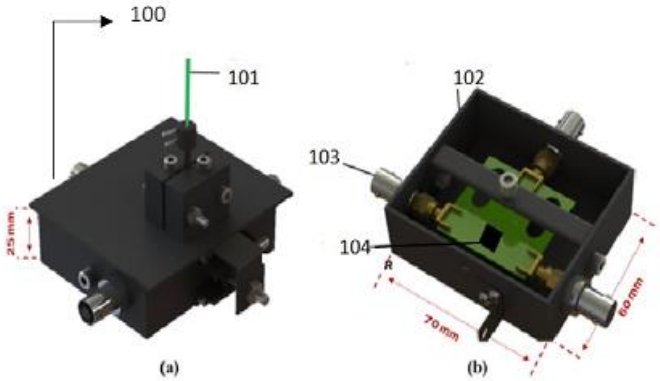

FIG. 1. Illustrates sensor module casing (external and internal view).

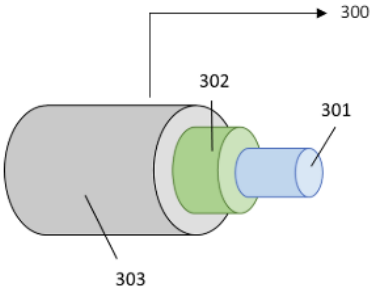

FIG. 2. Illustrates 2D material based fluorescent fiber fabrication.

Technology

1. **The 2D material-based coating significantly enhances the sensitivity of the optical fluorescent fiber sensor for detecting partial discharges (PD), providing more than double the sensitivity compared to uncoated fibers.**
2. **The fabricated sensor demonstrates optical emission spectrum in the UV range, with distinct emission lines at specific wavelengths, allowing precise detection of PD. Additionally, fast Fourier transform analysis reveals clear discharge signals.**
3. **The PD sensor with the 2D material coating shows substantial improvements in partial discharge inception voltage (PDIV), with enhancements of 34.8% for maximum deviation, 30.8% for surface discharge, and 17.7% for discharge due to particle movement, indicating higher efficiency and sensitivity in PD detection.**

CONTACT US
Dr. Dara Ajay, Head -TTO
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

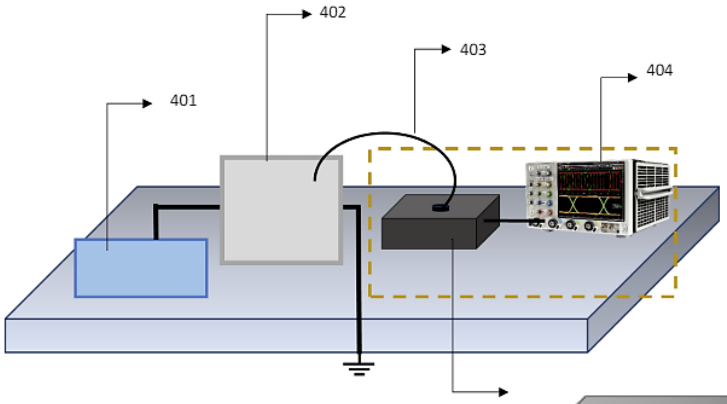

FIG. 3. Illustrates the experimental set up for PD Detection.

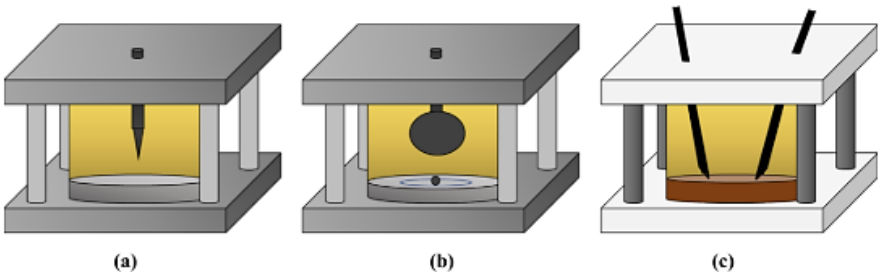

FIG. 4. Illustrates electrode configuration of (a) Corona discharge, (b) Surface discharge and (c) Particle movement.

Key Features / Value Proposition

1. Early Detection Capability

- Enhanced sensitivity of the fluorescent optical fiber with 2D material coating allows early detection of partial discharges in transformers.

2. UV Emission Spectrum

- The sensor module provides clear optical emission spectra in the UV range, aiding precise detection of discharge events.

3. Improved Signal Analysis

- Utilizing fast Fourier transform analysis, the sensor module offers signal sensitivity more than double that of uncoated fibers, enhancing accuracy in discharge detection.

4. Enhanced Inception Voltage

- The sensor module demonstrates increased partial discharge inception voltage (PDIV), enhancing reliability in identifying potential transformer faults.

CONTACT US
Dr. Dara Ajay, Head-TTO
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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