A DEVICE AND METHODS FOR DETERMINING THE ELEMENTAL IDENTITY AND ANALYSIS ON MOVING TARGET FROM A VARIABLE STAND-OFF DISTANCE

IITM Technology Available for Licensing

Problem Statement

- LIBS technique has applications in diverse areas such as forensic elemental analysis, environmental monitoring, real-time radioactive material tracking etc
- LIBS has advantages such as multi-element detection capabilities, in-situ analysis, minimal sample preparation requirements, minimal destructiveness, high detection sensitivity, and the ability to perform remote detections
- **Distance and height of the systems** remains as a major hurdle while finding a robust solution for **pollutant detection** on moving and rotating objects or targets

Technology Category/ Market

Category – Non Destructive Testing
Applications –Test Equipments, NDE, Optics, Sensors High Voltage installations
Industry- Environment Engineering,, Manufacturing
Market -The global advanced optics market size was USD 242.45 billion in 2020. The market is projected to grow from **USD 250.93 billion in 2021** to USD 477.42 billion in 2028 at a **CAGR of 9.62%** in the **2021-2028** period.

Key Features / Value Proposition

Technical Perspective:

- The present invention discloses an **optical device for detecting a contaminant or a pollutant layer on moving targets**
- By the combined effect of a photometric device, **an optical fiber, and a translation stage, the optical emissions originating from the plasma induced by laser action on a revolving target are encompassed.**
- Further, strategically positioning the optical fiber close to the focal plane, the measurement of pollutant layers **at different stand-off distances is attainable.**
- Device allows **coaxial laser ablation and remote detection**

User Perspective:

- The present invention can be utilized for **detecting a contaminant layer on wind turbine blades with considerable heights, ranging from tens to hundreds of meters**
- Can perform condition monitoring in structures such as monuments, bridge structues, high voltage installations, nuclear power plants etc.

Technology

The present invention discloses a device for determining the **elemental identity of optical emission generated by a laser beam irradiation on a moving target** with a **variable stand-off distance**, the said device arrangement comprising of:

- **An irradiating laser trigger means**
- **Adjustable focusing optical means**
- **A fixed aspheric mirror means**
- **A moveable beam diverting mirror means**
- **A holder means**
- **Optic fiber connected to optical emission**
- **Spectrometer associated with optic fiber**
- **A data acquisition means**

- **Laser Induced Breakdown Spectroscopy (LIBS)** technique is combined with a photometric device for determining the **presence of various elements and analysis of moving target material from a variable remote distance**
- Said technique is combined with temporal and spatial studies is demonstrated for detection and quantification of a salt deposit on a GFRP material.

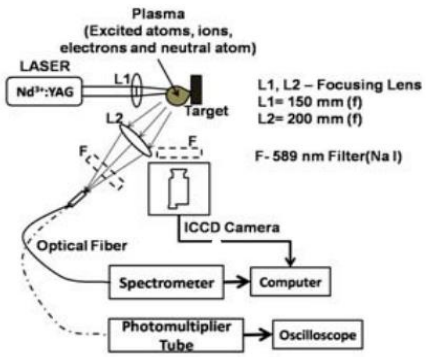

Fig. 1

- **The irradiating laser trigger means transmits laser beams towards the moving target**
- The **adjustable focusing means** includes focus mirror and a focusing lens to **focus the transmitted beams** from the laser trigger means on to **the moving target**

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- The irradiating laser trigger means transmits laser beams towards the moving target
- The **adjustable focusing means** includes focus mirror and a focusing lens to focus the transmitted beams from the laser trigger means on to the moving target
- Further, the said transmitted beams induce **plasma plume emission on the surface of the moving target**
- The fixed aspheric mirror focusses the induced plume emission from the surface of the moving target
- **The movable beam diverting mirror means**, which is two sided mirror receives the focused plasma emission from fixed aspheric mirror
- **Spectrometer** captures signals corresponding to plasma emission of the moving target , and **the data acquisition means receives** and stores the signals from the spectrometer

Images

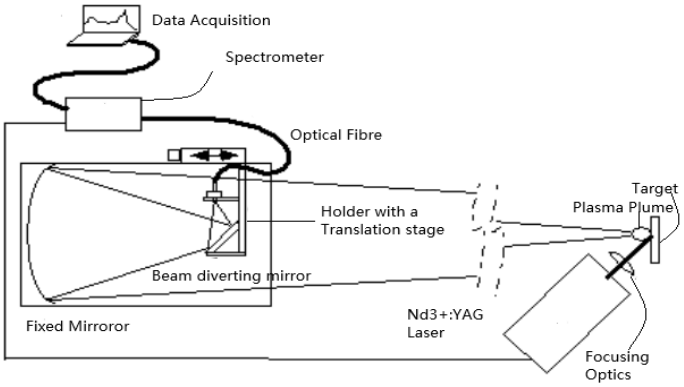

Fig.2 Experimental setup of remote LIBS system for variable stand-off distance measurements.

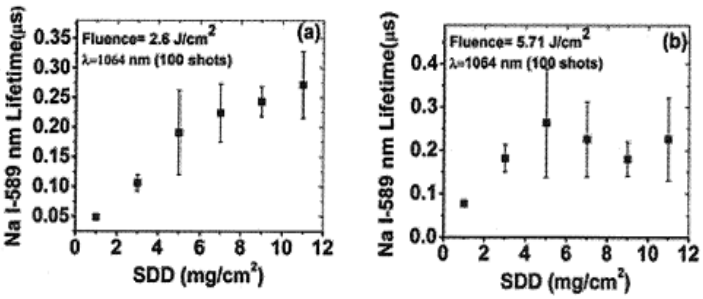

Fig.3 Influence of laser fluence on ranking the severity of salt deposit: (a) Fluence= 2.6 J/cm2 , (b) Fluence= 5.7 J/cm2

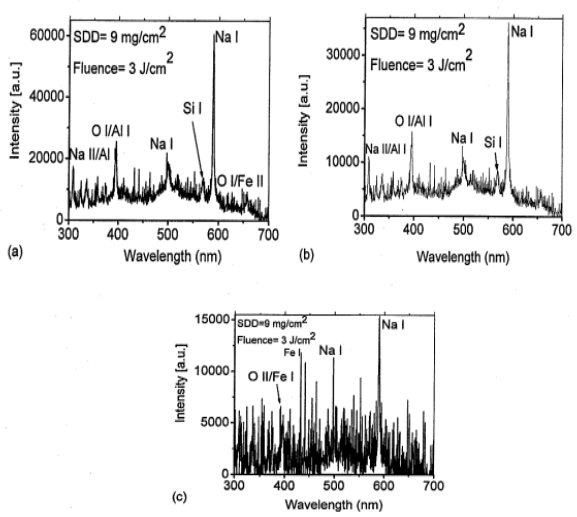

Fig.4 Remote LIBS measurements from stand-off distance of (a) 20 m, (b) 30 m, (c) 40 m.

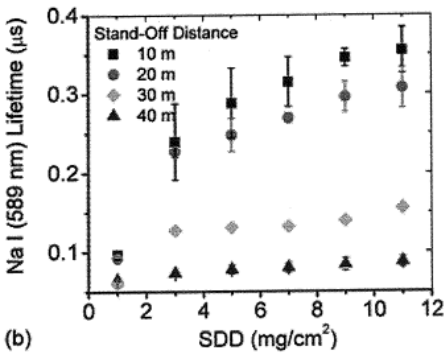

Fig.5 Measurement of salt deposition density with respect to Na I emission time-of-flight studies for different stand-off distances.

Intellectual Property

- **IITM IDF Ref. 1116**
- **IN314839-Granted**

TRL (Technology Readiness Level)

TRL- 3,Experimental Proof of concept

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