METHOD AND OPTICAL DEVICE FOR EXCITATION OF WHISPERING GALLERY MODE (WGM) IN MICRO-CAVITY STRUCTURE

IITM Technology Available for Licensing

Problem Statement

- In the instant, a **probing level** of **aquatic contaminants** is proposed with a fast & reliable opto-chemical sensor platform based on a surface-functionalized optical micro-resonator device (microbottle resonator) coupled naturally to an optical fiber.
- **Whispering gallery modes** (WGM) in microbottle resonators, is providing strong confinement of light carriers in very smallscale resonators.
- Further, a few prior arts have discussed related to excitation using a carefully aligned waveguide at the neck region of the micro bottle resonator, however **unable to provide solutions** in the scenario of **excitation of the WGM through the stem of the microbottle resonator.**
- Hence, there is a need to mitigate above challenges, which is addressed efficiently in the present invention.

Technology Category/ Market

Technology: Optical device for excitation of whispering gallery mode in a microcavity structure; **Industry:** Medical Industries, Environmental Monitoring, Defense, etc.;
Applications: Sensing Applications, Biomedical sensing, Fiber Optic Chemical Sensing, etc.
Market: The global **optical chemical sensors** market size is projected at a **CAGR** of **16.1%** during period of 2023-**2030.**

Intellectual Property

IITM IDF Ref.:2203; Patent No. 446634

TRL (Technology Readiness Level)

TRL- 3/4, Proof of Concept, Tested & validated

Research Lab

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Technology

- Present invention describes a **method for excitation of Whispering Gallery Mode (WGM) in a microcavity structure by an optical device.**
- **An optical beam with the OAM** comprises a **transverse field pattern** overlapping a transverse field pattern of the at least one WGM,
- The transverse field pattern of the **optical beam with the OAM** and the transverse field pattern of the at least **one WGM** is **helical** shown in figures.
- The optical device couples the optical beam with one of the **OAM possessing charge (l~10-500) vortices** comprising large off-axis Poynting vectors compatible with the excitation of the at least one WGM in the **micro-cavity structure.**

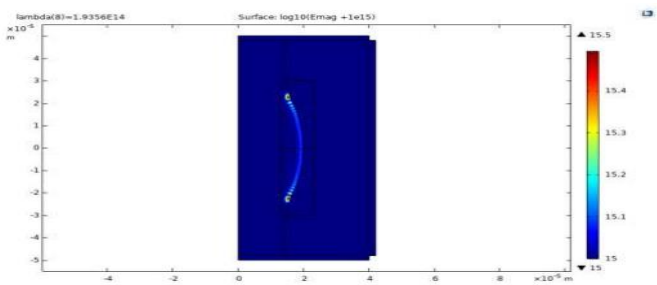

Fig.1a: Illustrates a graph for surface plot of **axi-symmetry structure** of **micro bottle resonating at 1.55 micron for m = 85**,

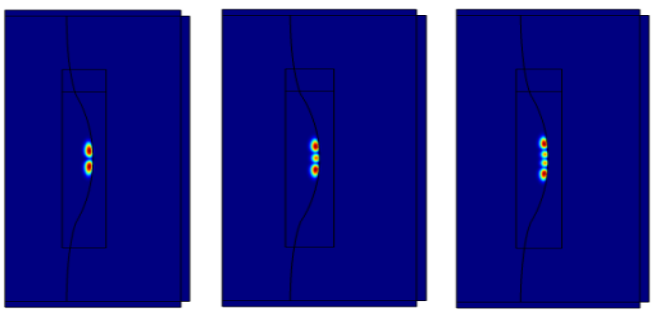

Fig.1b: Illustrates a graph for axi-symmetry microbottle for different q values (q=1, q=2, q=3).

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Technology

- **The method & optical device** for excitation of **whispering gallery mode** in a micro-cavity structure by passing **an optical beam** with orbital angular momentum from an end of **an optical cable** shown in fig.2 & flowchart.

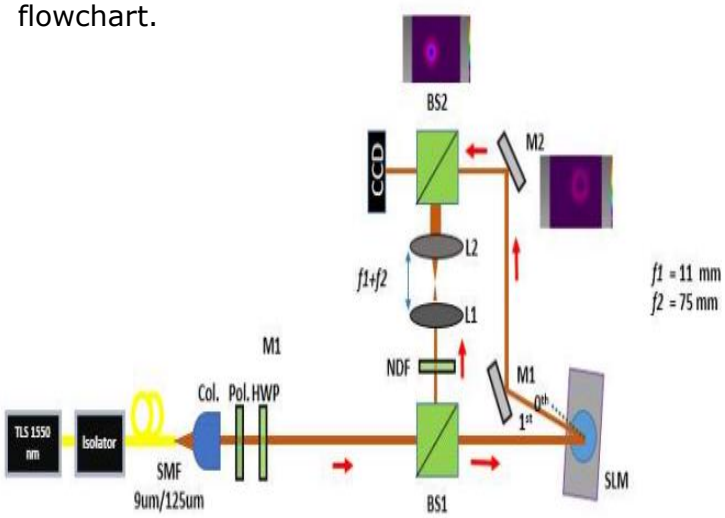
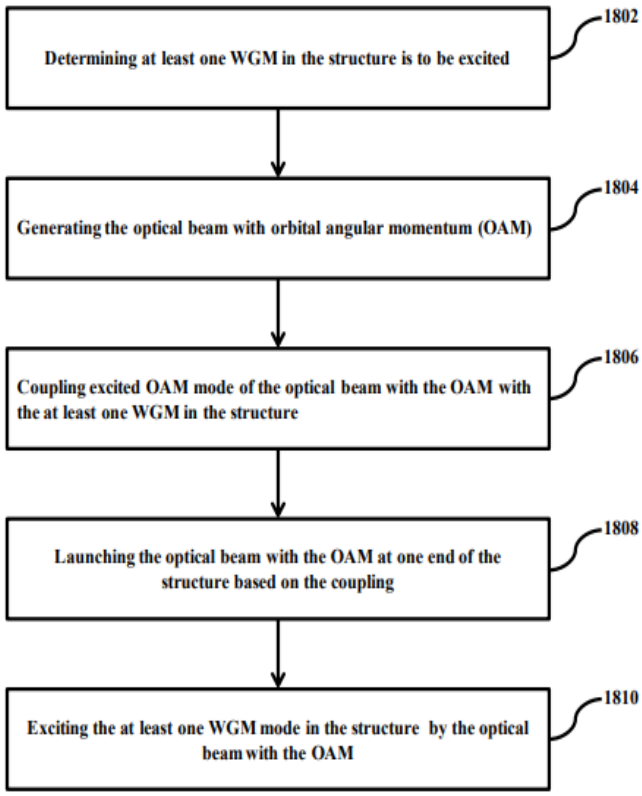


Fig.2 : Illustrates experimental schematic for generation of higher OAM charges and the quantification using interference technique;

Flowchart of proposed Method



Key Features / Value Proposition

❖ *Technical Perspective:*

- Present invention is focused on **optimizing the coupling efficiency** between the **OAM mode & the WGM** in micro bottle resonator as well as demonstrating the WGM excitation experimentally.
- The **coupling facility** is done by using an **active dopant** in the **micro-cavity structure.**
- **Bottle microresonators** can be **excited** (and the **signal** may be **extracted**) through the **fiber stems** associated with **the bottle micro-resonator**, making the **excitation mechanism** relatively **simple & robust.**
- **Field pattern of the WGM** is very **similar** to that of the **optical beam with the OAM,** hence the WGM in the structure, for example a **micro bottle resonator fiber** is excited using the **OAM beam**.
- Facilitates the optical frequency range i.e.**100s of THz**.

❖ *Industrial Perspective:*

- Provides a **cost-effective, simple, & eco-friendly method.**

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