



### Method & Apparatus for modifying dimensions of a waveguide IITM Technology Available for Licensing

#### PROBLEM STATEMENT

- The **challenge** associated with small cross-section waveguides are the **uniformity over large propagation lengths, core-cladding interface roughness** and **overall fabrication reproducibility**.
- In the conventional art, the problem arising of the local refractive index trimming techniques **cannot modify** the **dimensions** of the waveguide during a design phase.
- Hence, there is a need to address the issues.
- Present invention provide the solution in efficient manner by providing the modified dimensions of a waveguide.

#### INTELLECTUAL PROPERTY

**IITM IDF Ref. 1301; IN Patent No: 469080  
US Patent No. US10168479 (Granted)**

#### TECHNOLOGY CATEGORY/ MARKET

**Technology:** Apparatus for modifying dimensions of a waveguide;

**Industry & Application:** Photonic Devices, Optical interconnect devices, Optical Fibre, Semiconductor;

**Market:** The global optical waveguide market is projected to grow at a **CAGR of 13.87%** during **2024-2029**.

#### TRL (TECHNOLOGY READINESS LEVEL)

**TRL-4**, Proof of Concept ready, tested in lab.

#### TECHNOLOGY

- Present invention describes a **method & apparatus for modifying dimensions of a waveguide**.
- The method comprising a few steps illustrated hereinbelow:

#### 1<sup>st</sup> Step

- Positioning a shadow mask with an aperture** above the waveguide fabricated on a substrate.

#### 2<sup>nd</sup> Step

- Spatially filtering a substance**, by the apparatus through the aperture of the shadow mask on a portion of the waveguide, wherein the **substance** is a **vaporizing material deposited** with the **portion of the waveguide** to modify a cladding of the waveguide; and

#### 3<sup>rd</sup> Step

- Obtaining an adiabatic spot size converter** at end of the waveguide, by **adjusting a distance** between the **shadow mask** and the **portion of the waveguide**, to **modify the dimensions** of the waveguide. (Refer Fig.1)

#### Process Flow Diagram

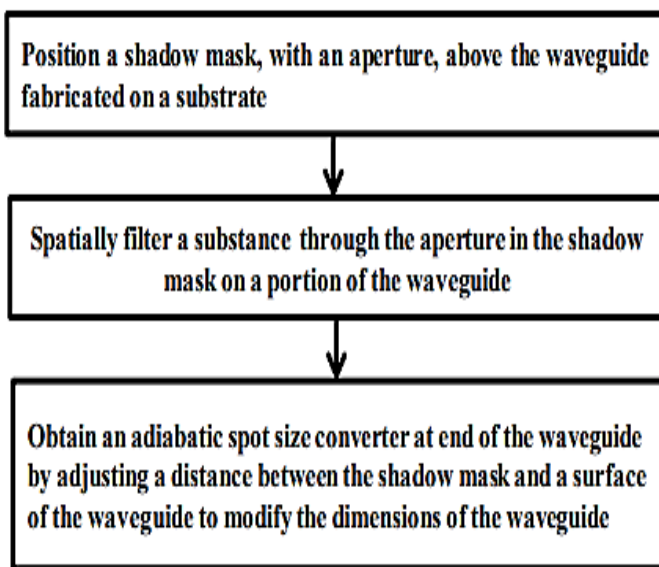


Fig.1

#### RESEARCH LAB

**Prof. Bijoy Krishna Das**  
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](mailto:smipm-icsr@icsrpis.iitm.ac.in)  
[sm-marketing@imail.iitm.ac.in](mailto:sm-marketing@imail.iitm.ac.in)  
Phone: +91-44-2257 9756/ 9719

### TECHNOLOGY (Contd.)

- Further the **apparatus** for modifying dimensions of a waveguide is illustrated herein. (Refer Fig. 2A-2F)
- The apparatus comprises one of a **reactive ion etching system** & a **deposition system**.
- Further, said apparatus includes a **shadow mask** which is with an aperture positioned above the waveguide, configured to **spatially filter a substance** through the aperture in the shadow mask on a portion of the waveguide.
- Furthermore, an **adiabatic spot size converter** is obtained at end of the waveguide.

### KEY FEATURES / VALUE PROPOSITION

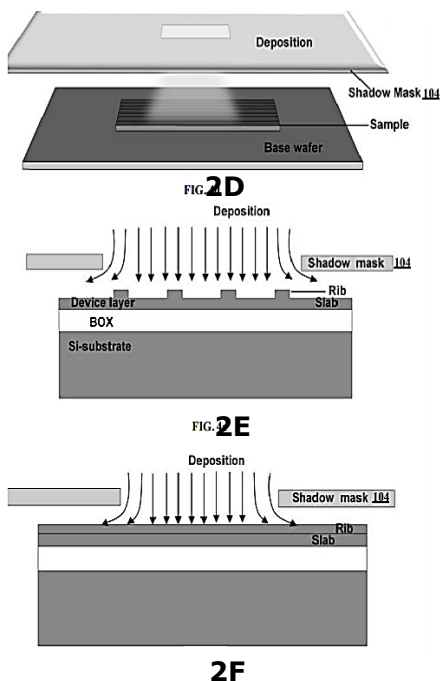
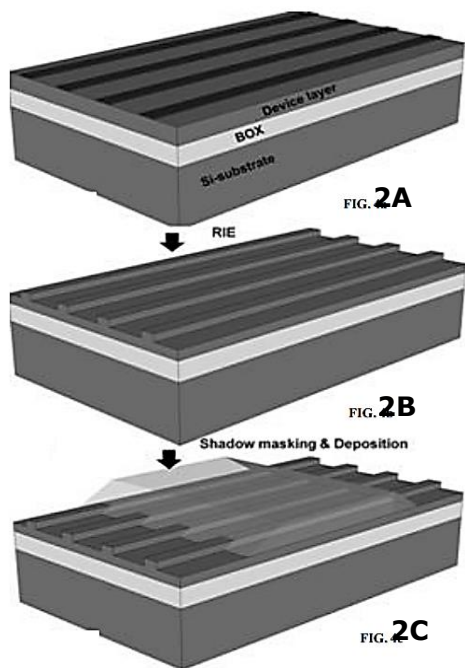
#### ❖ Technical Perspective:

- The **core dimensions** are **reduced** adiabatically.
- The length of uniformly trimmed waveguide section is **controlled** by adjusting the length of the shadow mask aperture alone.
- Provide modified dimensions of waveguide which plays a vital role in terms of **light coupling efficiency, effective refractive index, dispersion characteristics, mode-size simultaneously** at any desired location of pre-defined single mode silicon-on-insulator (SOI) waveguide.

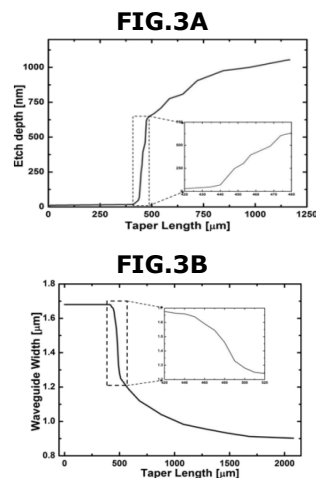
#### ❖ Industry Perspective:

- **Easily fabricated on a substrate.**
- Applicable both **silicon platform & all planar light-wave circuits.**

### Images



### Graphical Representation



**FIGs.3A, 3B:** Illustrates the schematic representations for measured etch depth & width variation of a spot-size converter (SSC).

Fig. 2a to 2f represents a process flow for fabrication of the waveguide & deposition of a vaporized material on a waveguide cladding with an adiabatic vertical tapering at both ends of the waveguides;

### 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](mailto:smipm-icsr@icsrpis.iitm.ac.in)  
[sm-marketing@imail.iitm.ac.in](mailto:sm-marketing@imail.iitm.ac.in)  
Phone: +91-44-2257 9756/ 9719