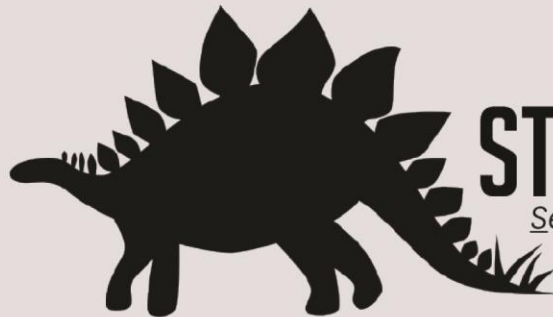


# **3D Printing Optical Switches**



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## 3D Printing Optical Switches

### What is/are 3D Printing Optical Switches?

Optical switches are used to connect fibers together to route signals. They act like a mechanical switch, either turning an optical signal on or off, or allowing the signal to move to a different output. 3D Printing is used to create micro and nano optical switches, especially when made by MEMS technology. There are Micro-optofluidic chips that are 3D printing that manipulate the laser beam by use of fluid in a channel.

### What are the possibilities?

Utilizing MEMS 3D Printing technology to create optical components, like optical switches, has led to more research in the recent past. Of more interest recently, 3D printing of waveguides and MEMS actuators in the nano-scale ( $0.5 \mu\text{m} \times 2 \mu\text{m}$ ) to improve telecommunications, sensors, wearables, etc. Combining both technologies allows for smaller switches and larger arrays, such as a  $32 \times 32$  matrix being produced.

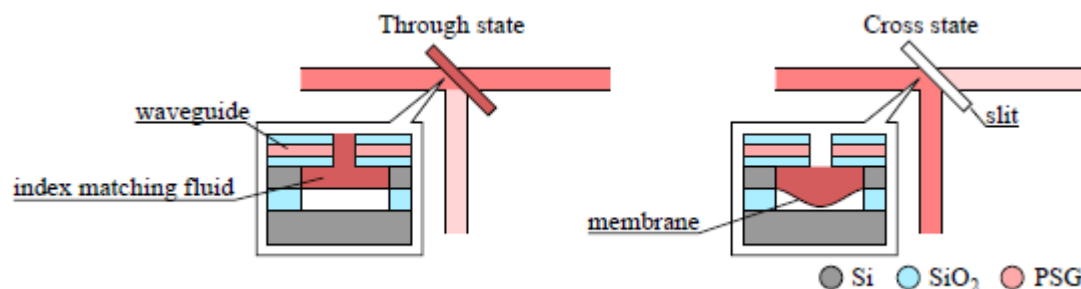


Figure 1:  $1 \times 2$  optical switch based on spoiling the total internal reflection with a fluid. (Insets) Cut-out view showing the electrostatic membrane actuator in the Through and Cross states (adapted from [65], Chollet, 2016, <https://doi.org/10.3390/mi7020018>, licensed under [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/))

### Applications in Additive Manufacturing/3D Printing

There have been multiple types of 3D printing, filament printing for larger devices, resin – SLA and DLP printing, and even the 2 PP process to allow fluorescence-based reading and writing of data to these optical devices (Ulrich, S., Wang, X. Rottmar, M. et al. Nano-3D-Printed Photochromic Micro-Objects. *Nano Micro Small*, 2021, 17, 5 <https://doi.org/10.1002/sml.202101337>).



### **Current Challenges & Weaknesses**

The biggest challenges are material. More research is needed on materials used to create the switches. Integrating the metals into polymer resins requires exploration to keep the metals suspended and have even deposition during the 3D printing process. Also, research is needed in the new fluorescent materials for the high-speed reading and writing of data.

### **Market Overview & Technology Game Changers**

For optical switching, optical components, utilizing 3D printing is changing the technology, especially in the nano realm. By miniaturizing the sensors, switches we can make these devices usable in more areas, such as automotive sensors, wearables, test instruments, telecommunication.

### **Time to Technical Confirmation & Time to Market Introduction**

This technology has been researched, but the latest research needs to be continued to make it commercially viable. There are paths forward, it will take more time to develop into a product for sale.



## References

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