

## SELF ASSEMBLY APPROACHES TO 3D PHOTONIC CRYSTALS

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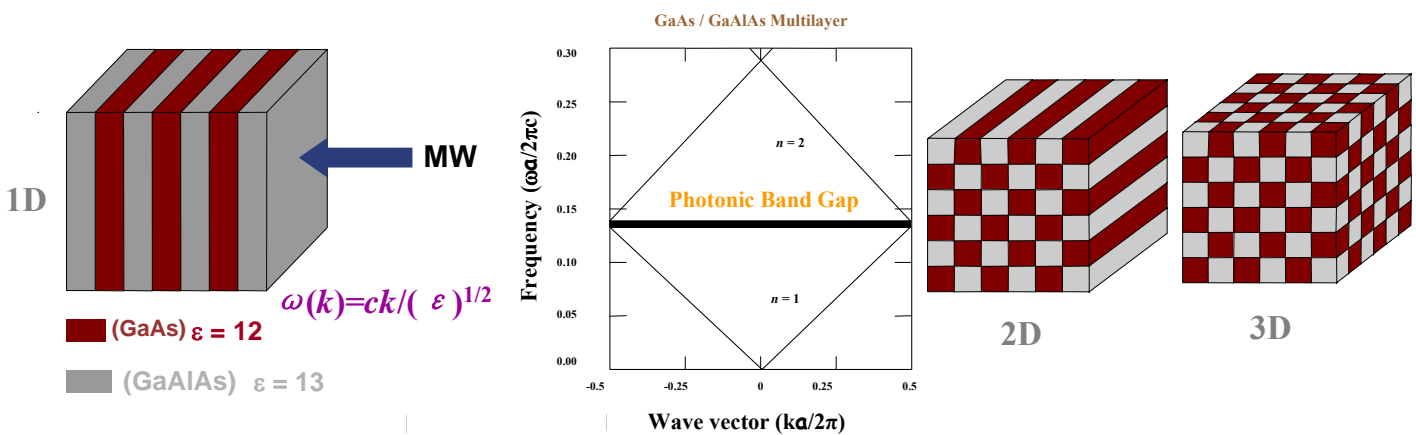
### Glossary

- **Photonics:** the technology of moulding the flow of photons.
- **Science of photonics:** light emission, transmission, reflection, amplification and detection by optical components, waveguide, lasers and other light sources, fiber optics, electro-optical instrumentation, related electronics, etc
- **Photonic crystals (or photonic bandgap materials):** spatially periodic structures with alternating regions of dielectric materials of different refractive indexes. Photonic crystals are classified into 1D, 2D, and 3D structures.
- **Self assembly:** a naturally occurring process by which objects automatically assemble into complexes.

### Why photonics?

- Speed and bandwidth limitations of electronics
- Demand for faster speed and higher information content
- Signal processing: the “electronic bottleneck”
- Photonic network: using photonic devices for information carrying and processing for network
- Other fields: medical and biotechnology
- Central to photonics is fabrication of PBG materials

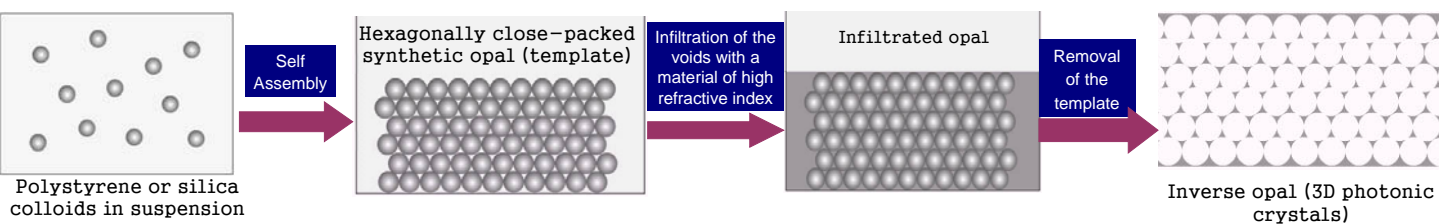
### The formation of Photonic Bandgap in Photonic Crystals



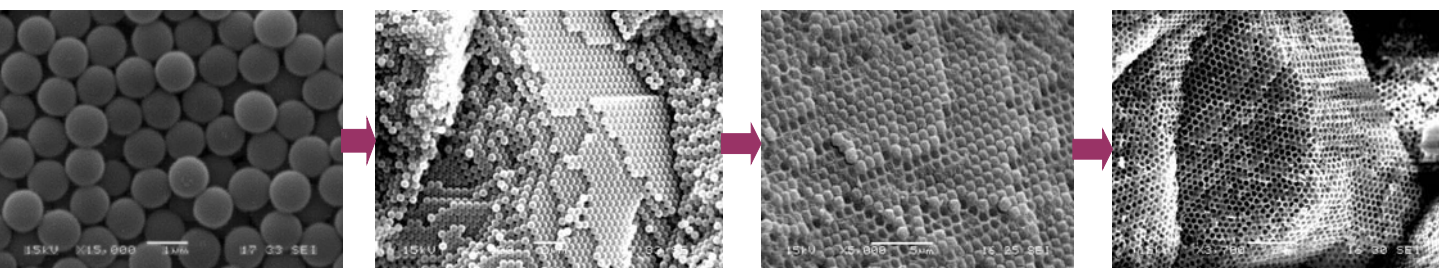
### Fabrication Techniques for Photonic Bandgap Materials

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| <p>(1) Conventional microlithography techniques (a “top-down” approach)</p> <ul style="list-style-type: none"> <li>- mature</li> <li>- feasible for 1D and 2D PBG materials</li> <li>- expensive</li> <li>- painstaking and time-consuming.</li> </ul> | <p>(2) Self-assembly systems as template (a “bottom-up” method)</p> <ul style="list-style-type: none"> <li>- simple, fast and cheap</li> <li>- impurity (hard to obtain a single phase in large domain)</li> <li>- defect issue (unwanted or wanted defects)</li> <li>- limited number of crystal structures</li> </ul> |
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### Self Assembly Approach to 3D Photonic Bandgap Materials



### 3D Silica Photonic Crystals Fabricated by using the Self Assembly Approach



### Concluding remarks:

- Photonics, a revolutionary technology, will have a similar impact on our society, as electronics did in the last century.
- Central to the photonic technology is the fabrication of photonic bandgap materials. Self assembly promises such materials.
- Breakthroughs have to be made in patterning photonic bandgap materials with desired properties such as waveguide property.
- Currently, the study of 3D photonic bandgap materials are in a stage as semiconductor heterostructures were in 1940s.
- The most challengeable part might be photonic devices and how to integrate such devices onto a microchip.