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# Monolithic White and Multi-Color Lasers Tunable in Full Visible Spectrum

Semiconductor lasers able to emit over the full visible color spectrum have a wide range of practical applications such as solid-state lighting, full-color displays, visible color communications, and multi-color fluorescence sensing. To the human eye, light with a mixture of four monochromatic lasers is visually equivalent to a white illuminant. Current technologies utilize non-semiconductor materials that result in bulky, inefficient systems that are also incompatible with electrical injection needed to incorporate them into electronics. The semiconductor-based approaches currently practiced to achieve this laser involve combining different materials and devices together resulting in complex, large, and costly systems. Therefore, the desire arises for a compact, tunable, monolithic laser capable of emitting both white and multi-color light.

Researchers at ASU have developed a multi-color monolithic semiconductor laser structure capable of emitting at three separate wavelengths that can be combined to produce white light. These structures are formed on SiO<sub>2</sub>/Si substrates using a combination of ion-exchange growth mechanisms in a single-zone chemical vapor deposition reactor. The technology's compact nature relies on a monocrystalline ZnCdSSe quaternary heterostructure nanosheet that contains three segments, each having a different alloy composition to emit a different color. At high enough pumping and temperature, each segment provides one of three primary colors, making it tunable. The novel growth method decouples the required alloy composition that produces a monolithic structure that is cheaper to integrate and easier to package.

### Potential Applications

- Laser Lighting
- Full-color imaging and display
- Biological and chemical inspection
- On-chip wavelength-division multiplexing (WDM)

### Benefits and Advantages

- Efficient - offers higher energy conversion luminescence efficiencies and potential output powers than white LEDs
- Low Cost - the monolithic structure unites all components into one laser so there is no need for separate, costly assemblies to achieve different wavelengths of color
- Innovative - the monolithic structure is able to produce lasing in any visible color-including white- under the right combination of the primary colors, which has never before been achieved
- Versatile - the laser has a vast field of potential applications ranging from full-

color imaging to on-chip purposes

For more information about the inventor(s) and their research, please see:

[Dr. Cun-Zheng Ning's directory webpage](#)

For more information about related technologies, please see:

[M12-056P: Generation and dynamical control of light of white or multiple colored \(wavelengths\) using alloy nanowires](#)