Miniature Laser Grown on Silicon Chip

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Miniature Laser Grown on Silicon Chip Latest News

Scientists from the US and Europe have successfully fabricated miniature lasers directly on silicon wafers, as published in a recent study in Nature.

About Miniature Laser Grown on Silicon Chip

- This is a **major advancement** in the field of **silicon photonics**, as **integrating a light source** (laser) directly on the chip has long been a **technological challenge**.
- Traditionally, lasers are **manufactured separately** and then attached to chips, which results in **slower operation**, **higher costs**, and **manufacturing mismatches**.
- The new research resolves this issue by **growing the laser directly** on a **silicon chip** using a **scalable process and compatible** with standard **CMOS (Complementary Metal-Oxide-Semiconductor) technology**, which is the backbone of current semiconductor manufacturing.
- Initially, **electrons** carried data within silicon chips. However, **modern advancements** are replacing electrons with **photons**, leading to the rise of **silicon photonics**.

- **Photons** carry information **faster**, with **higher bandwidth** and **lower energy loss** than electrons, making them ideal for **next-generation computing**, especially in **data centres**, **sensors**, and **quantum computing**.

Photonic Chip Components and Laser Physics

- A **photonic silicon chip** consists of four key parts:
    - A **light source (laser)**,
    - **Waveguides** to channel the photons,
    - **Modulators** to encode or decode data onto light signals, and
    - **Photodetectors** convert light into electrical signals.
- The **laser** functions on the principle of **stimulated emission**, where **electrons drop to a lower energy level**, releasing **coherent photons** to form a laser beam.
- However, **silicon has an indirect bandgap**, making it **inefficient at light emission**. Therefore, materials like **gallium arsenide (GaAs)** with a **direct bandgap** are preferred for laser construction.
- The setup was completed with a **protective layer of indium gallium phosphide** and **electrical contacts** to power the laser.

Source: TH
