多波长高速量子阱纳米线阵列微 LED 助力新一代片上光通信芯片

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基于外延生长的 In(Ga)As(P)/InP 量子阱纳米线制备而成的微纳 LED 在通信波长范围内具有巨大潜力，可以实现单片外延生长集成多个波段光源。制备好的器件还可以通过利用成熟的波分复用和多输入多输出技术提高数据传输容量。

澳大利亚国立大学由傅岚教授和 C. Jagadish 院士带领的课题组在基于选择性区域外延生长的 InGaAs/InP 单量子阱纳米线阵列微 LED 方面取得进展。该工作展示了基于 InGaAs/InP 单量子阱纳米线阵列的材料生长以及微 LED 器件的制备与表征。量子阱纳米线具有 p-i-n core-shell 结构，由选择性区域外延技术生长，且阵列形貌具有高度均匀性。其中轴向和径向量子阱分别在约 1.35 和 1.5 μm 波长处产生电致发光。纳米线阵列 LED 的轴/径方向上的量子阱各自的电致发光光谱波峰由于阱内能带填充效应都具有显著的外加偏压可调谐性，使得器件的复合光谱可以轻松覆盖通信波长范围 (1.35–1.6 μm)。另外，通过展示在同一衬底上单次纳米线生长即可获得具有不同阵列间距的 LED 像素矩阵，突显了基于量子阱纳米线制备而成微/纳 LED 光源与波分复用和多输入多输出技术在高速通信方面的极佳兼容性。该工作在开发新一代集成光通信系统芯片的微/纳尺度光源的研究道路上又迈出了一步。

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Multiwavelength high speed quantum well nanowire array micro-LED for next-generation on-chip optical communication

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Epitaxial grown In(Ga)As(P)/InP nanowires hold great potential for miniaturized LEDs and lasers at telecommunication wavelength range, as their wide bandgap tunability could enable monolithic integration of multi-wavelength light sources on a single chip through a single epitaxial growth, which could boost the data transmission capacity by wavelength division multiplexing and multiple-input multiple-output technologies.

The research team led by Profs. Lan Fu and Chennupati Jagadish at the Australian National University demonstrated the selective-area growth and fabrication of highly uniform p-i-n core-shell InGaAs/InP single quantum well (QW) nanowire array LEDs.

They have demonstrated selective area growth and fabrication of highly uniform p-i-n core-shell InGaAs/InP single QW nanowire array micro-LEDs, with axial and radial QWs contributing to the electroluminescence at wavelengths of ~1.35 and 1.5 μm, respectively. The electroluminescence spectra of the nanowire array LED exhibited strong bias-dependent spectral shift due to the band-filling effect, indicating a voltage-controlled multi-wavelength (1.35–1.6 μm) operation covering telecommunication wavelengths. The great compatibility of the nanowire array LEDs with wavelength-division-multiplexing and multiple-input multiple-output technologies for high-speed communication was further illustrated by the monolithic growth and fabrication of nanowire array LEDs with different pitch sizes and much-reduced array sizes (< 5 μm in width) on the same substrate, as well as GHz-level modulation.

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