# 分辨率高达 5 pm！超小型片上光谱仪有望用于智能手机

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随着消费电子时代的到来，仪器便携性需求越来越高，光谱仪小型化与集成化已成趋势。片上光谱仪在尺寸、重量、功耗及稳定性等方面具有先天优势。如何突破分辨率性能瓶颈是未来片上光谱仪应用于智能手机、大气环境监测、航天探测等诸多领域的关键。

针对片上光谱分析的重要需求，浙江大学光电科学与工程学院戴道锌教授研究团队提出了一种将超精细滤波与宽带滤波相融合的方案，并基于硅光技术实现了超高分辨率的超小型片上光谱仪。特别是，该团队引入欧拉弯曲型超高 Q 微环谐振腔作为超精细滤波器，从而极大地提升了光谱分辨率。与此同时，引入级联双环阵列作为粗滤波器组件，突破了精细滤波器自由光谱范围受限而导致的光谱探测范围问题。

该研究团队成功地制备了尺寸仅为 0.35 mm$^2$ 的超小型光谱仪芯片。结果表明，该片上光谱仪分辨率为 5 pm，实现了迄今世界上最高分辨率的色散型片上光谱仪。其工作光谱窗口约 10 nm，并实现了迄今报道的超小尺寸 (<1 mm$^2$) 片上光谱仪的最高动态范围 (即工作带宽/分辨率之比高达 2000)。该成果不仅在性能上突破色散型片上光谱仪分辨率不足的瓶颈，同时其制备与标准的 CMOS 工艺完全兼容，满足大批量生产的先天条件。

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# Ultrahigh-resolution on-chip spectrometer with silicon photonic resonators

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On-chip spectrometers have unique advantages in size, weight, power consumption and cost. It is still very challenging to realize on-chip spectrometers with ultra-high resolution for the applications in many fields such as smart phones, atmospheric monitoring, and Aerospace Exploration.

Recently the research group led by Prof. Daoxin Dai from the College of Optical Science and Engineering, Zhejiang University, China, proposed a silicon-based high-performance on-chip spectrometer with an ultra-compact size and an ultra-high resolution. In particular, the configuration consists of an ultra-narrow-band filter and wideband filters array was introduced.

The ultra-high-Q resonator was realized with Euler-bends, enabling ultra-high-resolution wavelength-selective filtering. Meanwhile, the wideband filter array was used to achieve an extended working window for the on-chip spectrometer. And the demonstrated on-chip spectrometer has a footprint as compact as 0.35 mm$^2$ and a resolution as high as 0.005 nm (which is the highest for on-chip dispersive spectrometers). The working window is about 10 nm and the ratio between the working window and the resolution is up to ~2000, which is the record for spectrometers with a footprint less than 1 mm$^2$. The proposed spectrometer breaks the bottleneck of insufficient resolution of the dispersive chip-level spectrometer.

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