基于石墨烯集成倾斜光纤光栅的光电器件

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倾斜光纤光栅（TFBG）作为一种新型的光纤器件，不仅具有梳状的特征光谱，而且在特定波长能够将光从纤芯耦合至光纤表面，进而实现光与物质的相互作用，并通过光谱特征表现出来。

西北工业大学的研究团队提出了一种石墨烯辅助的全光纤多功能光电器件。通过在 TFBG 表面集成少数原子层石墨烯，并在 TFBG 的弱倏逝场方向集成对称的金电极，辅助实现光纤结构中的光电转换和电致热光转换。TFBG 的倾斜栅面能够激发多种谐振模式，并借助石墨烯的偏振吸收效应，以及通过电极的光电流收集和电流注入，使其具有光-电-热信息的相互转换和感知功能。此外，TFBG 丰富的密集梳状光谱信息为探测光电流以及感知石墨烯层的弱电流信号提供了可观测的窗口。采用有限元分析法数值模拟 TFBG 的包层模场分布和光谱特征，理论上验证了石墨烯的偏振依赖特性，发现 S 偏振态下石墨烯吸收的光功率大于 P 偏振态下的光功率，对应不同的偏振依赖光电转换响应。当施加电流信号在石墨烯层时，基于石墨烯的电致热光效应，使得 TFBG 光谱出现整体的红移特性，且谐振波长移动与电流的平方呈现严格的线性关系。

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In-fiber photoelectric device based on graphene-coated tilted fiber grating

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Tilted fiber Bragg gratings (TFBGs), as a new photonic device, can also provide the strong evanescent field adjacent to the interface of fiber cladding to absorb, modulate, or convert the light signal into the electrical signal in the fibers by integrating the functional materials. Therefore, the combination of the graphene and all-fiber configuration provides a new opportunity for realizing integrated and miniaturized all-fiber photoelectric devices.

The research group from Northwestern Polytechnical University report the achievement of an in-fiber optoelectronic device assisted by graphene layer and two symmetrical electrodes for photoelectric and electric-induced thermo-optic conversions. In the device, a TFBG is used to provide a strong evanescent field and a multiresonant comb-like spectrum, the few-layer graphene acts as a photoelectric conversion medium as well as a micro-heater by the electrical injection, and the symmetrical electrodes are used to receive the photocurrent signal or apply the electrical signal. Therefore, the transmitted spectrum from this device consists of a dense comb of narrowband resonances that provides an observable window to sense the photocurrent and the electrical injection in the graphene layer. The spectral characteristics and modal distributions of TFBG's cladding modes are numerically simulated to theoretically verify the polarization-dependent absorption properties of graphene. In the experiment, the P-polarized and S-polarized resonances at different wavelengths are selected for photoelectric response test. Moreover, the wavelength-dependent photocurrent evolution allows the comb-like spectrum analysis of the TFBG and demonstrates a higher spectral resolution than the transmission scanned by a tunable laser.

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