微纳光纤中二次谐波的宽带连续光激发

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全光纤结构中二阶非线性光学效应的产生与转换效率提高，尤其是低功率、连续光泵浦的宽光谱二次谐波产生，是非线性光纤光学与器件领域亟需解决的基本问题，具有重要的科学意义和广泛的应用价值。

西北工业大学赵建林研究团队提出了一种层状硒化镓晶体与微纳光纤相集成方案，借助硒化镓晶体高二阶非线性和长程有序性，实现了宽光谱二次谐波的激发与多频率转换过程，为光纤中多种参量过程的增强以及宽带二次谐波光源的制备提供了新的解决方案。该方案中二次谐波与和频效应的高效激发主要取决于以下三个关键条件：硒化镓与微纳光纤较长的光与物质相互作用距离、层状硒化镓晶体的高二阶非线性和长程有序性、基频与倍频模式的相位匹配条件满足。实验中，使用火焰扫描拉锥系统制备的微纳光纤具有毫米级均匀锥区，为泵浦光与二次谐波提供了足够长的非线性作用长度；所集成的硒化镓晶体二阶非线性极化率超过 170 pm/V，远大于光纤的本征非线性极化率，且硒化镓晶体的长程有序结构确保了二次谐波持续的相长干涉，充分发挥了微纳光纤中较大非线性作用长度的优势；更重要的是，通过在微纳光纤制备过程中控制锥区直径进而调控波导色散，实现了泵浦光基模（HE11）与二次谐波高阶模（EH11、HE31）的相位匹配。

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Broadband and continuous wave pumped second-harmonic in microfiber

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Based on second-harmonic and sum-frequency effects, the lasers ranging from ultraviolet to far infrared bands have been generated, greatly promoting the development of laser techniques, optical information processing, high-resolution microscopic imaging.

The research group from Northwestern Polytechnical University proposed a scheme of integrating long-range ordered layered gallium selenide crystals into microfibers and achieved the broadband second-harmonic and multi-frequencies conversion. This provides a new solution for the enhancement of multiple parameter processes in the fiber and the development of quasi-monochromatic/broadband light sources. The efficient excitations of second-harmonic and sum-frequency effects in this scheme mainly depends on the following three key conditions: the long light-matter interaction length between gallium selenide and pump light, high nonlinearity of gallium selenide crystal, and satisfaction of phase matching conditions.

In the experiment, the microfiber prepared by a flame brushing system has a millimeter-level uniform tapered region, providing a sufficiently long nonlinear interaction length. The nonlinear susceptibility of gallium selenide is more than 170 pm/V, which is far greater than that of the pristine fiber, and the long-range ordered structure of the gallium selenide crystal ensures the accumulated constructive interference of the second-harmonic. By controlling the diameter of the microfiber in the fabrication and thereby modulating the waveguide dispersion, the phase matching between pump and second-harmonic modes is satisfied.

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