

## 论 文

### 掺杂LaF<sub>3</sub>:Er,Yb纳米颗粒的有机无机复合型平面光波导放大器的制备及增益测试

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#### 摘要:

采用油酸修饰的铈共掺杂氟化镧纳米颗粒掺杂的有机-无机杂化材料做为光波导放大器的有源层,同时采用光学性质良好的甲基丙烯酸甲酯-甲基丙烯酸环氧丙酯共聚物制作光波导的上下包层,首先说明了芯层材料不能刻蚀制备传统矩形波导的原因,其次设计了一种倒脊结构的平面光波导放大器,并采用蒸镀铝掩膜、紫外光刻和反应离子刻蚀等工艺,制备出放大器的样品,同时对样品端面进行了化学机械抛光处理,在信号光(1 550 nm)功率为1 mW的条件下,在1.9 cm长度的波导上获得了3.2 dB的相对增益.

**关键词:** 平面光波导放大器 LaF<sub>3</sub>:Er,Yb纳米颗粒 倒脊型光波导 增益特性

### Fabrication and Gain Measure of LaF<sub>3</sub>:Er,Yb Doped Organic-inorganic Waveguide Amplifier

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#### Abstract:

Oleic acid modified LaF<sub>3</sub>:Er,Yb nanoparticles were prepared and doped in organic-inorganic hybrid material as the active layer of waveguide amplifier.Polymethyl-methacrylate-glycidyl-methacrylate,an excellent and transparent optical polymer material,was used as the top and bottom layers.During the process of waveguide fabrication,the reason why active layer cannot be etched were instructed.And an embedded ridge structure waveguide amplifier was also designed.The device was fabricated by aluminium mask vacuum evaporation,UV lithography and reactive ion etching method (RIE) process.Waveguide end-faces were polished in order to get high gain.At last,a 3.2 dB relative gain was obtained in a 1.9 cm length sample (signal power was 1mw and pump power was 188 mW).

**Keywords:** Planar waveguide amplifier LaF<sub>3</sub>:Er,Yb Embedded ridge waveguide Gain characteristics

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#### 参考文献:

- [1]HAN H S,SEO S Y,SHIN J H,et al.Optical gain at 1.54 μm in erbium-doped silicon nanocluster sensitized waveguide[J].Appl Phys Lett,2001,79(27): 4568-4570.
- [2]LI Cheng-ren,SONG Chang-lie,LI Shu-feng,et al.Er-doped Al<sub>2</sub>O<sub>3</sub> thin films fabricated by sol-gel processes and measurement of photoluminescence characteristics[J].Acta Photonica Sinica,2003,32(12): 1514-1517.

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[3]LI Jian-yong,WANG Li-ge,LI Cheng-ren,et al.Optimization of photoluminescence for Yb<sup>3+</sup>/Er<sup>3+</sup>+co-doped Al<sub>2</sub>O<sub>3</sub> films[J].Acta Photonica Sinica,2006,35(11):1746-1750.

李建勇,王丽阁,李成仁,等.铒铈共掺Al<sub>2</sub>O<sub>3</sub>薄膜光致发光特性优化[J].光子学报,2006,35(11):1746-1750.

[4]LI Cheng-ren,LI Shu-feng,SONG Qi,et al.Characteristics of net gain of Yb : Er co-doped Al<sub>2</sub>O<sub>3</sub> waveguide amplifier[J].Acta Photonica Sinica,2006,35(5):650-654.

李成仁,李淑凤,宋琦,等.铒铈共掺Al<sub>2</sub>O<sub>3</sub>光波导放大器的净增益特性[J].光子学报,2006,35(5):650-654.

[5]BO S,WANG J,ZHAO H,et al.LaF<sub>3</sub> : Er,Yb doped sol-gel polymeric optical waveguide amplifiers [J].Appl Phys B,2008,91(1):79-83.

[6]WONG W H,PUN E Y B,CHAN K S.Er<sup>3+</sup> - Yb<sup>3+</sup> codoped polymeric optical waveguide amplifiers [J].Appl Phys Lett,2004,84(2):176-178.

[7]ZHANG Dan,CHEN Cong,CHEN Chang-ming,et al.Optical gain at 1 535 nm in LaF<sub>3</sub> : Er,Yb nanoparticle-doped organic-inorganic hybrid material waveguide[J].Appl Phys Lett,2007,91(16):161109.

[8]QUANG A Q L,HTERLE R,ZYSS J,et al.Demonstration of net gain at 1 550 nm in an erbium-doped polymer single mode rib waveguide[J].Appl Phys Lett,2006,89(14):141124.

[9]WONG W H,CHAN K S,PUN E Y B.Ultraviolet direct printing of rare-earth-doped polymer waveguide amplifiers[J].Appl Phys Lett,2005,87(1):011103.

[10]ZHANG Dan.An experimental and theoretical study on erbium-doped polymer waveguide amplifier [D].Changchun: Jilin University,2008:72,64.

张丹,掺铒有机聚合物光波导放大器的理论与实验制备[D].长春:吉林大学,2008:72,64.

[11]GU Hao-ran,JIN Guo-liang,LOU Na et al.Analysis of overlap factor between pump-and signal-light intensity profiles in Er-doped waveguide amplifier[J].Acta Optica Sinica,2007,27(9):1643-1648.

顾浩然,金国良,娄娜,等.掺铒玻璃波导放大器中抽运光信号光重叠因子分析[J].光学学报,2007,27(9):1643-1648.

[12]AHN Bok-Yeop,SEOKA Sang-II,HONG Suk-in,et al.Optical properties of organic/inorganic nanocomposite sol-gel films containing LaPO<sub>4</sub> : Er,Yb nanocrystals[J].Optical Materials,2006,28(4):374-379.

[13]CHEN Cong.Study on Er<sup>3+</sup>-Yb<sup>3+</sup> Co-doped polymeric planar optical waveguide amplifiers fabricated on Si substrate[D].Changchun: Jilin University,2010:72.

陈聪.铒铈共掺有机聚合物硅基平面光波导放大器的研究[D].长春:吉林大学,2010:72.

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