

文章编号: 0253-2239(2007)02-0354-6

光学参变啁啾脉冲放大相位失配啁啾脉冲 频谱整形新方法

邓青华^{1,2} 彭翰生³ 张小民¹ 李明中¹ 隋展¹ 丁磊¹ 王建军¹
唐军¹ 罗亦鸣¹ 赵润昌¹ 李富全¹ 林红奂¹ 吕新杰^{1,2} 王明哲⁴

1 中国工程物理研究院 激光聚变研究中心, 绵阳 621900
2 中国工程物理研究院 研究生部, 绵阳 621900
3 中国工程物理研究院院部, 绵阳 621900
4 国防科技大学光电部, 长沙 410073

摘要: 相位匹配是实现高效光学参变啁啾脉冲放大(OPCPA)能量转换的关键之一,通过对几种常用非线性晶体的光学参变啁啾脉冲放大过程进行数值模拟研究,结果表明一定程度的相位失配不但能增加光学参变啁啾脉冲放大增益带宽,而且会使啁啾脉冲光谱强度分布中间凹陷。提出利用光学参变啁啾脉冲放大相位失配放大作为啁啾脉冲频谱整形的新方法,通过理论分析和模拟计算,找到了光学参变啁啾脉冲放大相位失配啁啾脉冲频谱整形效果的控制量;并对几种常用非线性晶体在简并、近简并、非简并等条件下的光学参变啁啾脉冲放大相位失配放大特性进行了比较。

关键词: 超快光学; 啁啾脉冲; 频谱整形; 光学参变啁啾脉冲放大; 相位失配

中图分类号: TL612.3 文献标识码: A

New Method of Chirped-Pulse Spectrum Shaping Using Phase Mismatched Optical Parametric Chirped Pulse Amplification

Deng Qinghua^{1,2} Peng Hansheng³ Zhang Xiaomin¹ Li Mingzhong¹ Sui Zhan¹
Ding Lei¹ Wang Jianjun¹ Tang Jun¹ Luo Yiming¹ Zhao Runchang¹
Li Fuquan¹ Lin Honghuan¹ Lü Xinjie^{1,2} Wang Mingzhe⁴

1 Research Center of Laser Fusion, China Academy of Engineering Physics, Mianyang 621900
2 Department of Postgraduate, China Academy of Engineering Physics, Mianyang 621900
3 Headquarter of China Academy of Engineering Physics, Mianyang 621900
4 Department of Optoelectronics, National University of Defense Technology, Changsha 410073

Abstract: Phase matching is one of the important keys for high-efficiency energy conversion in optical parametric chirped pulse amplification (OPCPA). With simulation on the OPCPA process of several conventional nonlinear crystals, it is found that the spectra of output signal from phase mismatched OPCPA is broadened, and the center of spectra is depressed. It is proposed that the phase mismatched OPCPA can be a novel method for spectra shaping of chirped pulses. The parameters influencing the spectra shaping process is given. The amplifying characteristics with OPCPA phase mismatching for several conventional nonlinear crystals under degenerate, quasi-degenerate and non-degenerate conditions are compared.

Key words: ultrafast optics; chirped pulse; spectrum shaping; optical parametric chirped pulse amplification; phase mismatching

作者简介: 邓青华(1976—),女,湖南人,博士研究生,主要从事高功率激光技术方面的研究。

E-mail: dqhaj@yahoo.com.cn

导师简介: 彭翰生(1936—),男,山东人,研究员,主要从事等离子体物理和超短脉冲激光技术方面的研究。

E-mail: penghsh@caep.ac.cn

收稿日期: 2006-03-29; 收到修改稿日期: 2006-11-23