Nanosecond pulse compression by SBS technique and investigations of its SHG characteristics

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Pulse compression devices for nanosecond (ns) duration pulses could find applications in material processing, resonance Raman spectroscopy (RRS), etc. However, pulse compression techniques used for fs - ps time domains cannot be applied to ns pulses. Outside of the optical resonator, pulse compression from several ns to sub-ns can be achieved only by stimulated Brillouin scattering (SBS) nonlinear light-matter interaction process.

We investigate pulse compression characteristics of moderate energy (~ mJ), tunable ns pulses from a Ti:Sapphire laser (15 Hz, 15 ~ 30 ns, 10 ~ 30 mJ, 680 – 1000 nm) operating in the gain-switching mode. In our previous reports [1, 2], we have described and demonstrated a variable length, compact/folded SBS amplifier cell and discussed its performance dependence on the effective interaction length of the amplifier at ~800 nm. In this report, we will present and discuss experimental results describing the wavelength-dependent compression characteristics of tunable nanosecond pulses in different media (FC72, FC40 fluorinates) in terms of energy conversion efficiency, pulse compression factor, and brightness.



Figure 1. (a) Wavelength dependence of the pulse FWHM for FC40 and FC72 SBS liquids (L ~ 1. 5 m).(b) Pulse energy and conversion efficiency for FC72 after the compression (FC40 shows similar results).

In Fig. 1(a) the wavelength dependence of the pulse compression for L = 1.5 m effective interaction length amplifier cell and different SBS liquids are presented. As expected, due to the shorter phonon lifetime (0.2 vs. 1.2 ns), the pulse width compression in FC40 vs. FC72 was more efficient. The SBS energy conversion efficiency, on the other hand, was below 0.6 (below 0.7, if ~ 20 % linear optical losses are taken into consideration). Our analysis shows that the main reason for this is the short coherence length (L_c) of the pump pulses (L_c ~ 2 cm, bandwidth ~ 15 GHz).

Experiments are now in progress to investigate the SHG conversion efficiency and stability of the compressed pulses in a broad spectral region. The results of these experiments will also be presented and discussed at the conference.

- [1] H. Chosrowjan, et al., presentation No.: 24p-P05-5 第 69 回応用物理学会春季学術講演会
- [2] H. Chosrowjan, et al., presentation No.: 21p-P04-5 第 83 回応用物理学会秋季学術講演会

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