高出力耐性CNT-BNNT可飽和吸収体を用いたモード同期ファイバーレーザ

Mode-locking fiber laser using a high power tolerant saturable absorber incorporating CNT-BNNT

東大先端研[1] 東大機械工[2] ○(M2C)袁 鵬涛[1]、張 哲元[1]、横川 翔子[1]、鄭 永嘉[2]、金 磊[1]、
ｾｯﾄ ｼﾞｲﾖﾝ[1]、丸山 茂雄[2]、山下 真司[1*]

Tokyo Univ. RCAST[1] Tokyo Univ. Mech. Eng.[2] ○(M2C) P. Yuan[1], Z. Zhang, S. Yokokawa, Y. Zheng[2], L. Jin[1],
S.Y. Set[1], S. Maruyama[2], and S. Yamashita[1*]

E-mail: syama@cntp.t.u-tokyo.ac.jp

CNT-BNNT is a newly demonstrated vdW heterostructures 1D nanomaterial from the combination of Carbon nanotube (CNT) and Boron Nitride nanotube (BNNT) [1]. A BN layer is grown to wrap around CNT by chemical vapor deposition (CVD), which helps improve the overall optical damage threshold. In this report, we compare the optical damage properties of CNT-BNNT with pristine CNT. A 1-GHz-repetition-rate mode-locked fiber laser employing these high power durable CNT-BNNT nanomaterials is then demonstrated.

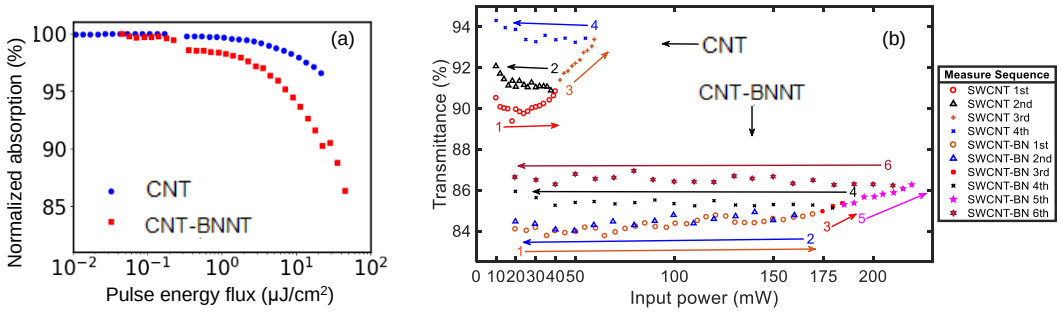

Fig. 1. (a) Saturable absorption characteristics of CNT and CNT-BNNT. (b) Damage threshold measurement of CNT and CNT-BNNT

Figure 1(a) shows the saturable absorption characteristics of the CNT and CNT-BNNT films sandwiched between single-mode fiber ferrules measured using a 750-fs pulsed laser at 1560 nm. Fig. 2(b) illustrates the optical transmittance of the CNT and CNT-BNNT films with 1560 CW laser light focused in free space with a beam diameter of 2.6 μm. The launched power was varied from low to high and then back from high to low repeatedly, in order to investigate the onset of any irreversible optical damage. The arrows and numbers indicate the measurement directions and sequences. BNNT helps improve CNT film the optical damage threshold up to 5 times without changing overall optical transmittance characteristics. Fig. 2(a) shows the laser setup incorporating CNT-BNNT. The laser is a 10-cm-long Fabry-Perot laser. The output is stretched pulse train with 1.07 GHz repetition rate whose spectrum and RF spectrum are shown in Fig. 2(b) and Fig. 2(c). The total cavity optical power is 320 mW, which will damage CNT in the same cavity.

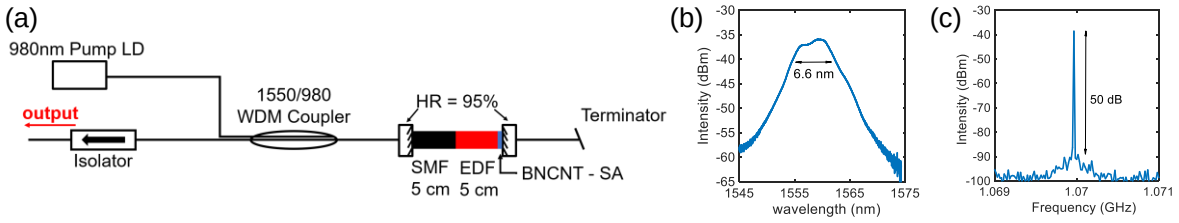

Fig. 2. (a) Laser setup. (b) Output spectrum. (c) Output RF spectrum

In this paper, we compared the optical properties of pristine CNT and CNT-BNNT. BNNT improves CNT the optical damage threshold up to 5 times and slows down the degradation rate. With high power durability, CNT-BNNT can be applied in the higher power optical field where CNT cannot be applied.

Ref: [1] X. Rong, T. Inoue, and Y. Zheng, "One-dimensional van der Waals heterostructures," *arXiv preprint arXiv:1807.06154* (2018).