비정질 실리콘의 3차비선형 효과에 대한 근접장 광학 연구

Near-field optical study of 3rd order Nonlinear properties of amorphous silicon

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The 3rd order nonlinear properties show Optical bleaching (Saturation) and Reverse saturation in absorption aspect, whereas Self-focusing[3][4] and Self-defocusing in refraction aspect. Optical bleaching and Self-focusing phenomena of those properties in particular can be useful to make the optical beam spot size smaller for application on the higher optical storage density.

In our case, amorphous silicon layer is used to investigate the effect of 3rd order nonlinear material on the spot size. The amorphous silicon(A-Si) layer is deposited by the method of PECVD on the corning 1737 fusion glass and its thickness is 300 nm.

Two experiments are carried out in this work. One is the far-field Z-Scan and the other is the near-field Z-scan[1][2] where the laser beam spot is scanned by NSOM in the near field region from the material. The following diagram describes the far-field Z-Scan experiment which is for investigating the general 3rd order nonlinear properties of amorphous silicon. Far field Z-Scan experiment can be divided into two sub-experiments, i. e., open aperture Z-scan and close-aperture Z-scan.

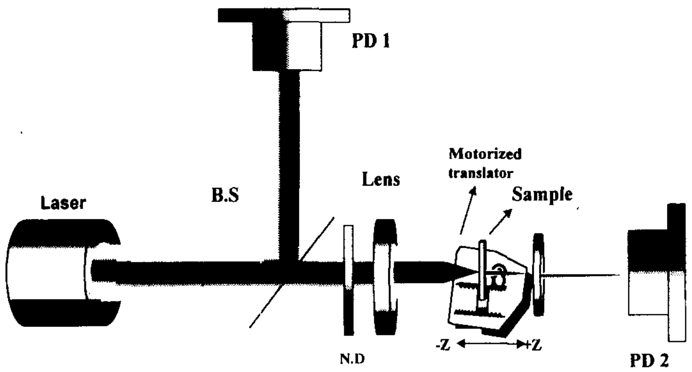

Fig. 1 The diagram of far-field Z-Scan.

The transmittances with and without the aperture were recorded by two detectors(PD1, PD2) in a single scan respectively when a beam splitter was used. By using Beam Splitter, one beam was detected by PD1 as a reference beam. The other beam passed N.D filter, a lens and sample moved around the focus of Lens motorized by translater and then the beam was focused again to be detected by PD2. By the data of PD1 and PD2, the normalized transmittance(PD2/PD1) curve can be acquired. By the transmittance curve with and without a aperture, nonlinear absorption for A-Si can be calculated. The transmittance curves depending on the input intensities are in Fig. 2. and Fig. 3. The far-field Z-scan shows Reverse saturation and Self-focusing properties for the A-Si layer. This results mean that A-Si layer can make beam spot size smaller and larger simultaneously. So it is need to investigate the change of beam spot size by the effect of A-Si layer. For that, near field z-scan method is used in this experiment. By near-field Z-Scan the spot sizes depending on the input intensities can be investigated directly. Fig. 4. and 5 show the apparatus of near field Z-scan and the results respectively.

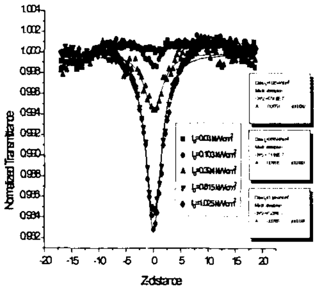

Fig 2. The transmittance curves with respect input beam intensities for A-Si in open aperture Z-scan.

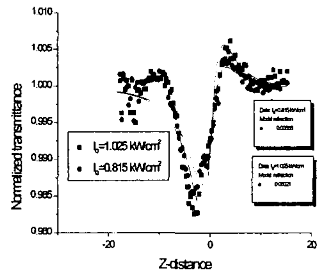

Fig. 4.3 The transmittance curves with respect to to input beam intensities for A-Si in close aperture Z-scan

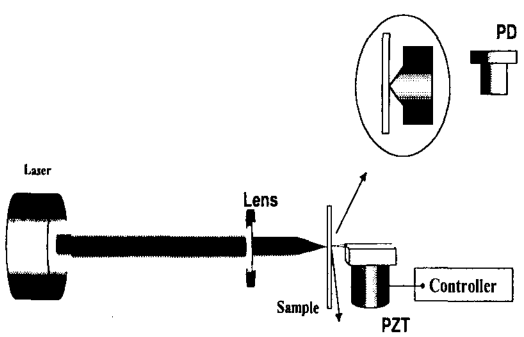

Fig. 4. Near field Z-Scan apparatus

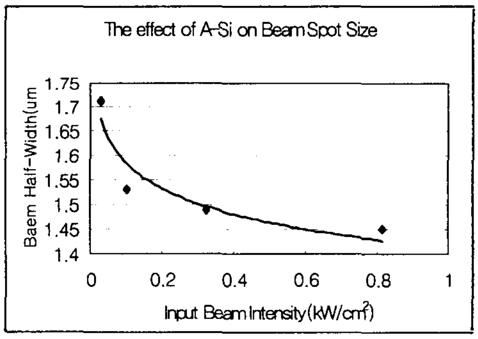

Fig. 5.The effect of A-Si layer on optical beam spot size.

This presents the change the beam spot size as a function of the input beam intensity for the A-Si layer. As a result, the stronger the input beam intensity is, the smaller a beam spot size is obtained for A-Si layer. As a result, A-Si as a nonlinear material can be used to enhance optical data storage.

Reference

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