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SHORT COMMUNICATION

OPTICAL RECORDING IN SULFUR-SELENIUM LAYERS

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Selenium-sulphur layers prepared by warm pressing or deposited by pulsed laser deposition (PLD) on silicon wafers were subjected to laser pulses in order to test the possibility of recording the optical information in these glassy materials. There was demonstrated that the contrast of reflectivity between the irradiated places and the amorphous matrix could be used for storage of information at a reasonable density.

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The chalcogenide materials are very sensitive to light in the non-crystalline (amorphous or glassy) state [1 - 14]. The interest in the chalcogenide optical memory effects was manifested by an increased number of papers published in the last years [15 - 22]. Phase-change memories have been produced [23].

Thick glassy layers of $Se_{53}S_{47}$, composition in the Se-S system, have been prepared by warm pressing the melted composition. The eutectic composition $Se_{42}S_{58}$, doped by paraffin, was used as target for thin film preparation by PLD on silicon wafers. Reports on laser pulse effects in Se-S glassy layers and the characterisation of PLD films have been recently published [24,25].

For testing the optical inscription of information in Se-S layers a Q-switch YAG:Nd laser [26], designed by us, has been used. The laser can be triggered to emit mono and double pulses on the wavelength of λ=1.064 μm. The diameter of the laser beam in the focussing point is 20 μm. The length of a pulse is 10 ns. The standard energy in the absence of filters is 10 mJ/pulse. A double pulse exhibits 35 mJ. The image of the region of the layer irradiated by the laser pulse is observed by reflection and is recorded by a computer connected on-line. The reflection in the irradiated zone is visualised by the white light projected from a lamp.

The results obtained in our experiments are shown in the Figs. 1-3.

Fig. 1 shows the effect of the laser pulse on the layers based on self-sustained $Se_{53}S_{47}$ composition. It is remarkable that the reflectivity of the material strongly increases after irradiation. The structural transformation of the chalcogenide alloy is stable and probably related to the phase separation effect, if compared with similar effect on reflectivity in other chalcogenide alloys. The irradiation with mono-pulses gives rise to narrow reflectivity zone and more contrast.

Fig. 2 shows the effect of laser irradiation in thin amorphous films of $Se_{42}S_{58}$ doped by 10 % paraffin (thickness: 2.8 μm). The effects of the laser pulses are more drastically, as revealed by crater like picture at the impact position of the laser pulse. In spite of small craters visible on the film, the change of reflectivity (increase) is clearly expressed. The new phase formed as a result of irradiation is stable in time.

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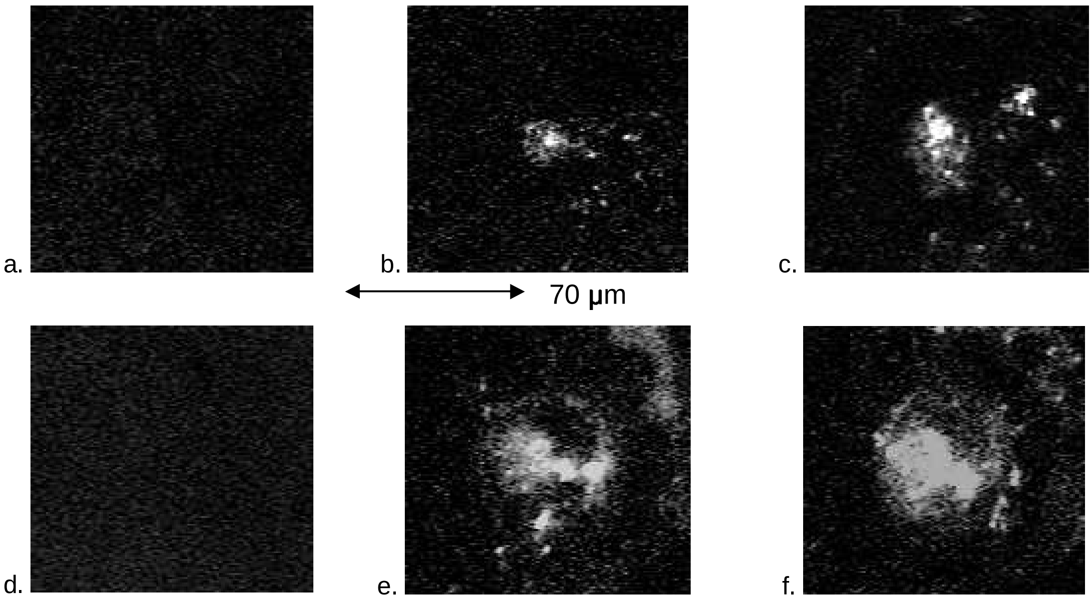

Fig. 1. The effect of the laser pulses on the optical recording medium based on the chalcogenide composition $Se_{53}S_{47}$.

First series:
a. Virgin state b. after mono-pulse irradiation c. after 5 mono-pulses irrad.

Second series
d. Initial state e. after double pulse irradiation f. after 5 double-pulses irrad.

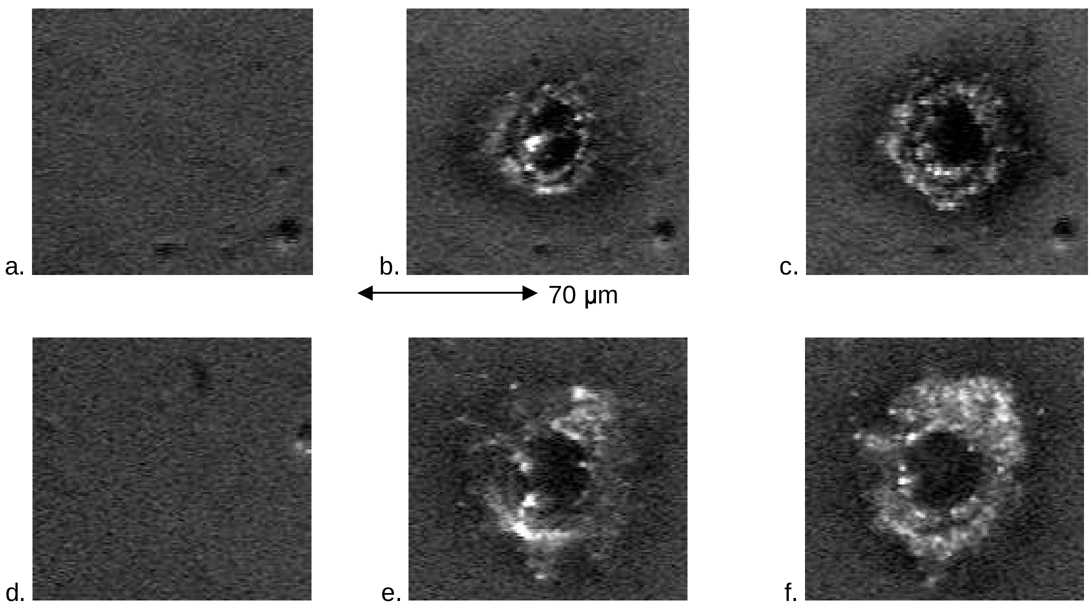

Fig. 2 The effect of the laser pulses on a thin film of amorphous chalcogenide alloy $Se_{42}S_{58}$ doped by paraffins (10 % wt.). The film has been deposited by excimer laser (PLD method).

First series :
a. Virgin state b. after mono-pulse irradiation c. after 5 mono-pulses irrad.

Second Series
d. Virgin state e. after double-pulse irrad. f. after 5 double-pulses irrad.

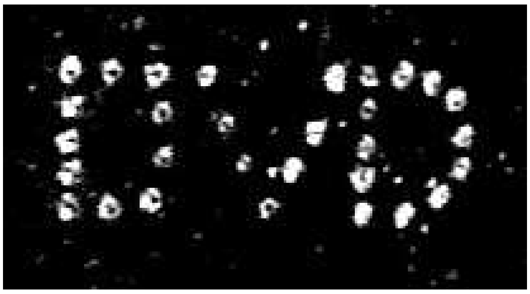

Fig. 3. Illustration of the ability of recording the optical information on the surface of the chalcogenide material based on $Se_{42}S_{58}$ doped by paraffin (10 % wt.). Every point has been inscribed with a double-pulse emitted by the YAG:Nd layer (E=35 mJ; τ=10 ns). The visualization of the inscription is made in white light, by reflection on the chalcogenide film deposited on silicon wafer.

Fig. 3 shows the aptitude of the Se-S films doped by paraffin to record optical signal by laser pulses that scan a large area of the recording film.

In conclusion, the strong effect related to the reflectivity change of Se-S surface layer, under the action of the YAG:Nd laser pulses suggests the use of the non-crystalline material as medium for optical storage of information. The memory effect should be based on the change of reflectivity of the chalcogenide film, induced by laser pulses. The recording density depends on the focused source of radiation and on the optics used in the inscription device.

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