A

Seminar report

on

“Data Storage On Fingernail”

Submitted in partial fulfillment of the requirement for the award of degree of Bachelor of Technology in Computer Science

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Acknowledgement

I would like to thank respected Mr…….. and Mr. ……..for giving me such a wonderful opportunity to expand my knowledge for my own branch and giving me guidelines to present a project report. It helped me a lot to realize of what we study for.

Secondly, I would like to thank my parents who patiently helped me as i went through my work and helped to modify and eliminate some of the irrelevant or un-necessary stuffs.

Thirdly, I would like to thank my friends who helped me to make my work more organized and well-stacked till the end.

Next, I would thank Microsoft for developing such a wonderful tool like MS Word. It helped my work a lot to remain error-free.

Last but clearly not the least, I would thank The Almighty for giving me strength to complete my report on time.

Preface

I have made this report file on the topic **Data Storage On Fingernail**; I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude to …………..who assisting me throughout the preparation of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

INTRODUCTION

Recently, there have been rapid developments in the field of information technology, resulting in the need to generate, store, and transport a large amount of information while ensuring data security, an important issue in today's digital age. To meet future demands in information technology, **femtosecond laser** pulse processing offers a powerful tool for developing new high-capacity devices because it allows fabrication of three-dimensional (3-D) structures inside a wide range of transparent materials. In particular, multilayered 3-D optical bit recording is a promising technique for next-generation computing systems because it offers a large recording capacity by stacking many recording layers without increasing the recording density per layer . Our goal is to realize optical data storage in a human fingernail for highly secure data transportation that does not suffer from problems such as theft, forgery, or loss of recording media .

Japanese researchers are using femtosecond laser pulses to write data into human fingernails .Secure optical data storage could soon literally be at your fingertips thanks to work being carried out in Japan. Yoshio Hayasaki and his colleagues have discovered that data can be written into a human fingernail by irradiating it with femtosecond laser pulses. Capacities are said to be up to 5 mega bits and the stored data lasts for 6 months - the length of time it takes a fingernail to be completely replaced. (Optics Express 13 4560)

Fingernail storage "I don't like carrying around a large number of cards, money and papers," Hayasaki from Tokushima University told Optics.org. "I think that a key application will be personal authentication. Data stored in a fingernail can be used with biometrics, such as fingerprint authentication and intravenous authentication of the finger."

BASIC APPROCH

The team's approach is simple: use a femtosecond laser system to write the data into the nail and a fluorescence microscope to read it out. The key to reading the data out is that the nail's fluorescence increases at the point irradiated by the femtosecond pulses. Initial experiments were carried out on a small piece of human fingernail measuring 2 x 2 x 0.4 mm3. The writing system comprises a Ti:Sapphire oscillator and Ti:Sapphire amplifier. Pulses of less than 100 fs at 800 nm are then passed through a microscope and focused to three set depths (40, 60 and 80 microns) using an objective lens. Each "bit" of information has a diameter of 3.1 microns and is written by a single femtosecond pulse. A motorised stage moves the nail to create a bit spacing of 5 microns across the nail and a depth of 20 microns between recording layers.

An optical microscope containing a filtered xenon arc lamp excites the fluorescence and reads out the data stored at the various depths. "We regulate the focus with the movement of the microscope objective," explained Hayasaki. "The distance between the planes is set to prevent cross-talk between data stored at different depths. "Hayasaki adds that the same fluorescence signal is seen 172 days after recording.

Although the initial experiments have concentrated on small pieces of nail, the team is now developing a system that can write data to a fingernail which is still attached to a finger. "We will develop a femtosecond laser processing system that can record the data at the desired points with compensation for the movement of a finger," said Hayasaki.

DATA IS LITERALY ON FINGER NAIL

As technology and science develop, new, more advanced means of storing data are discovered. However, up until know, nobody thought of using the human body as a storage media .

According to Jacqueline Hewett for physicsweb.org, Yoshio Hayasaki of Tokushima University and colleagues have discovered that data can be written into a human fingernail by irradiating it with femtosecond laser pulses. Capacities are said to be up to 5 mega bits and the stored data lasts or 6 months, which is the length of time it takes a fingernail to be completely replaced.

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The team's approach is simple: use a femtosecond (10-15 seconds) laser system to write the data into the nail and a fluorescence microscope to read it out. The key to reading the data out is that the nail's fluorescence increases at the point irradiated by the femtosecond pulses. Initial experiments were carried out on a small piece of human fingernail measuring 2 x 2 x 0.4 cubic millimetres. The writing system comprises a Ti:Sapphire oscillator and Ti:Sapphire amplifier. Pulses of less than 100 femtoseconds at 800 nanometres are then passed through a microscope and focused to three set depths (40, 60 and 80 microns) using an objective lens.

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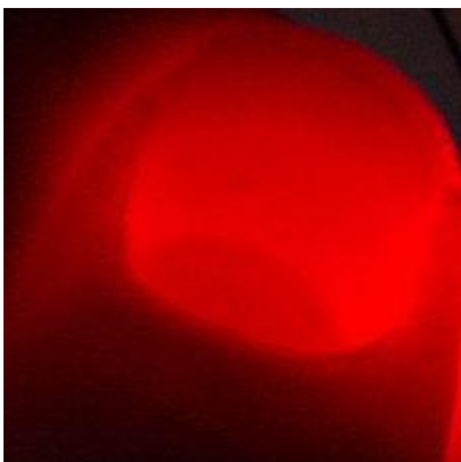

DNA STORAGE VS FINGERNAIL STORAGE

Storing messages in DNA it might be interesting to explore ways to encode large volumes of data directly into parts of the human body. Storing data in DNA has the advantage that data is distributed throughout the entire body. Furthermore, if stored in the sex-cells, stored data can be passed down to offspring. A disadvantage of using DNA for data-storage is the possible unanticipated effects on cell development and health. Messing with DNA is risky -- it may be safer to store data in other parts of the human body (with the one potential disadvantage that such data would not be passed down via heredity).Storing data on fingernails is a safe process. Using this technology we save our data without having its bad effect on body.thus it is a safer process as compared to DNA STORAGE. Here are some suggestions for parts of the human body that might be good media for data-storage:

Fingernails

It may be possible to encode data on fingernails. This could be accomplished via micro-etching onto the surface or better yet, via holographic etching within the matrix of the fingernail itself. An advantage of using fingernails to store data is that you could easily read the data by inserting a finger into a scanning device. Also, different fingernails could be used for different data partitiions. One disadvantage is that fingernails grow and eventually data would be lost if not refreshed -- however this might actually be a feature in that the storage is self-expiring which could be useful when you want data to be permanently removed from storage.

OTHER PARTS OF HUMAN BODY IN WHICH DATA CAN BE STORED

The lens of the eye.

The lens of the human eye may provide a good medium for encoding data. Data would be written into it using laser holographic etching. An advantage of this approach is that biometric authentication of user-access to data could be integrated with the data itself. For example, to access the data that is encoded onto the lens of your eye, you would look into a reader that would first do an iris scan to authenticate your identity and permission to read the data, and would then read/write the data as you request. A disadvantage of using the lens to store data is that it might not be reusable -- it may be difficult to erase or overwrite data on the lens, although the jury is still out on this question. Another important consideration would be to ensure that the data encoding did not interfere with vision, although it is not expected that this would be a problem as it is easy to encode data microscopically such that it would not affect visual refraction.

Teeth.

Data could potentiallyl be encoded into teeth, although it would be difficult to write and read it off later. Furthermore, food and fluids in the mouth could potentially interfere with read/write operations. This is probably a non-optimal storage solution!

Hair

Strands of human hair would be good media for storing data. Data could be etched into the hair strand using a laser. The advantage of this is that the body has lots of hair and it is constantly being regenerated, so there would be an infinite supply of storage and rather than worrying about how to erase or overwrite, you could simply use a different strand of hair to encode new data. The disadvantage is that hairs are easily lost, which could make data stored on hairs a bit fragile. Another problem is that it might be difficult to locate the data once stored -- since presumably a given person has more than just a single hair on their body, which would require some method of locating the particular hair containing the particular data of interest. One solution might be to redundantly encode the same data on all the hair in a given region, say the forearm of a person, such that any hair from that region would contain a complete copy of the data.

HOW DATA IS STORED ON FINGERNAILS

There is an increase in fluorescence intensity compared with the surrounding auto-fluorescence intensity at a structural change produced by a focused femtosecond laser pulse inside a human fingernail. The spectrum of the increased fluorescence coincides with the auto-fluorescence spectrum of a fingernail and that of pure keratin. The increased fluorescence intensity is also observed in a heated fingernail. It is suggested that the increased fluorescence is a result of a local denaturation of keratin protein caused by the femtosecond laser pulse irradiation. The increased fluorescence effect is very useful for reading out the bit data recorded inside a human fingernail. We also demonstrate that three-dimensionally-arranged structural changes can be read out with little cross-talk by making use of the increased fluorescence. Furthermore, we demonstrate that fluorescence can be observed for up to 6 months, corresponding to the time required for a fingernail to grow from root to tip.

APPARATUS USED

An optical system for recording bit data inside a human fingernail is composed of :

1. femtosecond laser system
2. an optical microscope.

The femtosecond laser system is composed of a mode-locked Ti:sapphire laser pumped by a diode-pumped solid state continuous-wave green laser and a multi-kilohertz pulsed Ti:sapphire regenerative amplifier pumped by a diode-pumped Nd-YLF laser . A femtosecond laser pulse with a central wavelength of 800 nm and a pulse width of less than 100 fs (FWHM) is introduced into the optical microscope.

The optical microscope system has a computer-controlled three-axis motorized stage. In most experiments, a 40· objective (numerical aperture (NA) = 0.55) is used.

(A) A sample on the motorized microscope stage is observed with a charge coupled device (CCD) image sensor under transmitted illumination.

(B) The recording depth *Z* is defined as the distance moved along the optical axis by the microscope stage.

(C) The zero depth is determined by microscope observation of the sample surface.

(D) When the focusing position is inside the sample, *Z* is positive.

(E) The irradiation pulse energy *E*p described is the product of the energy easured at the entrance of the microscope and the transmittance of the microscope system, including transmittance of the objective.

(F) The transmittance of the microscope is 0.49.

(G) The sample is a small piece of human fingernail whose size is about 2·2 ·0.4 mm3, and its surface is polished with abrasive lapping films .

(H) The surface polish reduces the required pulse energy for processing because the scattering and the distortion of the wavefront are decreased. .

The optical setup for reading out the bit data

fluorescence microscope consisting of a
(A) xenon arc lamp as an exciting light source,
(B) filter blocks.Each of the filter blocks consists of an excitation filter which is a band-pass filter ,a dichroic mirror (DM), which is a high-pass filter , and a barrier filter (BA), which is a high-pass filter .
The spatial distribution of the fluorescence and the spectrum of a small area of the fingernail are observed with a CCD image sensor and a spectrometer

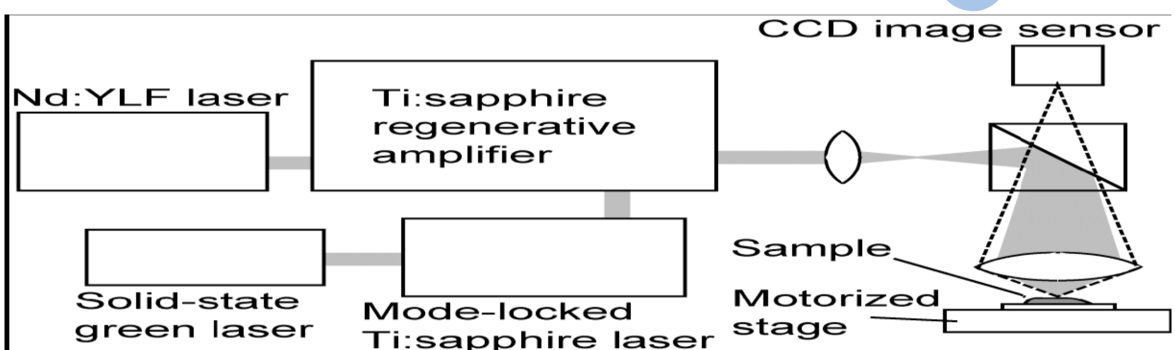

FIGURE1

DATA STORING ON NAILS

When the femtosecond laser pulse is focused inside a material, molecules are subjected to multi-photon ionization and optical field ionization at a local volume where the laser pulse is focused. Consequently, the ionized molecules repulse each other, and a microexplosion occurs, which causes a structural change in the material. Figure 2 shows transmission-illumination microscope observations of three bit arrays recorded inside a human fingernail. By changing the value of Ep data at various layers are stored. The laser ionizes the photon and these photon carry data.
FIGURE BELOW SHOW THE DATA STORAGE AT DIFFERENT LEVELS.

FIGURE 2

DATA READING FROM NAILS

It has been observed that there is an increased fluorescence at the structural changes formed in the fingernail compared with the auto-fluorescence of the fingernail. This change occur due to ionization of molecules .
Comparing these changes data can be retrieved. Image taken by microscope is compared with the earlier fluorescence and accordingly a graph is plotted. This graph is further analyse to obtain the data in the form of bits.
Fluorescence images are show in figure 3 &4

figure

Conclusion

We have demonstrated an increased fluorescence intensity at the structural change inside a human fingernail produced by a focused femtosecond laser pulse. The fluorescence intensity was higher than the surrounding auto-fluorescence intensity of the fingernail. The structural changes, whose geometrical shape drastically depends on the irradiated pulse energy, are observed as a dark region by using a microscope with transmission illumination. The increased fluorescence intensity was observed in the dark region. The spectrum of the increased fluorescence coincided with the auto-fluorescence spectra of the fingernail. The increased fluorescence intensity was also observed in a fingernail heated in a drying oven. It is suggested that the increased fluorescence of the structure is a result of a local denaturation the keratin protein caused by heat generated by the femtosecond laser pulse irradiation.

We demonstrated that the increased fluorescence of the structure is useful for reading out three-dimensionally recorded data inside a human fingernail. We recorded three bit planes inside a human fingernail. We demonstrated that three bit planes can be read out with little cross-talk by using fluorescence readout. Furthermore, we demonstrated that fluorescence can be observed for up to 6 months, corresponding to the time required for a nail to grow from root to tip. Under these recording conditions, a recording density of 2 Gbit/cm3 is achievable.

When the recording performed on an accessible volume of 5 × 5 × 0.1 mm3, the recording capacity of the data is 5 mega bits.

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