Atomic Holographic Optical Storage Nanotechnology

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ABSTRACT

Colossal Storage Inc. has exclusive license patent rights on new ways of non - contact reading and writing with non destructive reading of information to a ferroelectric molecule. These methods will be used to develop the worlds first 2 D / 3 D Area / Volume Holographic mass storage device. U.S. Patents, # 6,028,835 2/00 and # 6,046,973 4/00 for an integrated read/write head for ferroelectric optical media.

Keywords: Ferroelectric, holographic, storage, volume, UV, atomic switch.

INTRODUCTION

For the first time in history, a design concept for fabrication of a laser semiconductor component used for reading/writing data to an optical holographic disk drive storage product will be explained. A unique new approach never tried before by any company, corporation, research facility, university, military, independent private or public research. The FE 3 D Holographic Optical Drive technology plans to push future storage densities of optical mass storage up to 40,000 Terabits/cu.cm. A comparison with 2 D Area magnetic hard drives of today is around at 60 gigabits.[1] Optically assisted 2 D Area drives at 45 gigabits/sq.in. and 2 D Area contact recording AFM, STM, SPM or SFM, i.e. atomic force microscope and their derivatives, at about 300 gigabits/sq.in..[4]

2 D AREA / 3 D VOLUME ATOMIC HOLOGRAPHIC MASS STORAGE

The holographic optical drive will use the Einstein/Planck Theory of Energy Quantum Electrons to control molecular properties by an atoms electron movement/displacement, Fig. 12, 14, 17. The FeDrive - FeHead Semiconductor Integrated Optical Read / Write Head plans to use lenseless Ultraviolet/Blue laser diodes with Voltage transducer to write, new definition of term include photon induced electrical field poling, and UV/Blue laser diode and Nanooptical transistor or Nanofloating gate Mos Fet to read. Research and development on techniques and functions for controlling ferroelectric perovskite's dipole properties write, erase and storage states in nanocrystal memories will need to be created. The techniques developed would be for fast read/write control of ferroelectric molecules, i.e., atomic switch, Fig. 13, 15, 16, which have a persistence of 100 years or more.[3] Increasing areal densities and data transfer rates of data between the random mass storage device to system requirements will increase mass storage bandwidth needs. Many more proprietary holographic methods and processes have been conceptualized for future development and research.

FIRST METHOD OF READING/WRITING TO FERROELCTRIC MOLECULE

The peripheral drive uses an ultra-violet or deep blue light source with an applied electric field orientation transducer for writing.[5] Reading is done by a second deep blue or ultra-violet light source that is diffracted/refracted off of the ferroelectric perovskite dipole molecule surface to a nanoopto photo diode that is able to detect small changes in the diffraction of the ultra-violet or deep blue light from the ferroelectric perovskite molecule Fig. 2. Writing is done when the output of the ultra-violet or deep blue light source emits photons and ferroelectric molecules absorb the photons energy creating electron movement from the valence orbit to the conduction orbits of the ferroelectric molecule Fig. 1. When the applied field has a positive voltage potential the electrons move towards the transducer and vice versa for a negative potential. When the ultra-violet light source and applied fields are both turned off the ferroelectric molecule stays in the orientated direction and stores the random electric field positive/negative potential Fig. 3, i.e. a molecular or atomic switch, which also causes the ferroelectric molecule to physically elongation or shrink up to 1.5%. The stored electric field difference (voltage) of the ferroelectric molecule is permanently changed until ultra-violet or deep blue laser light and the applied field is turned on again to

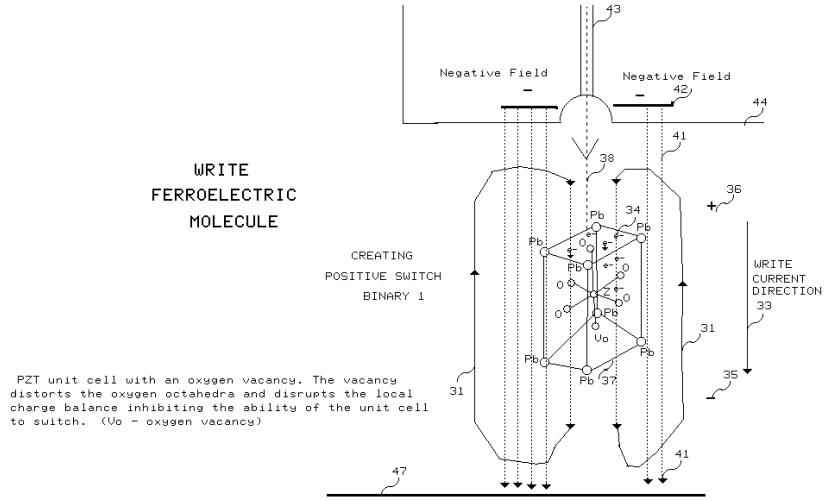


Fig. 1

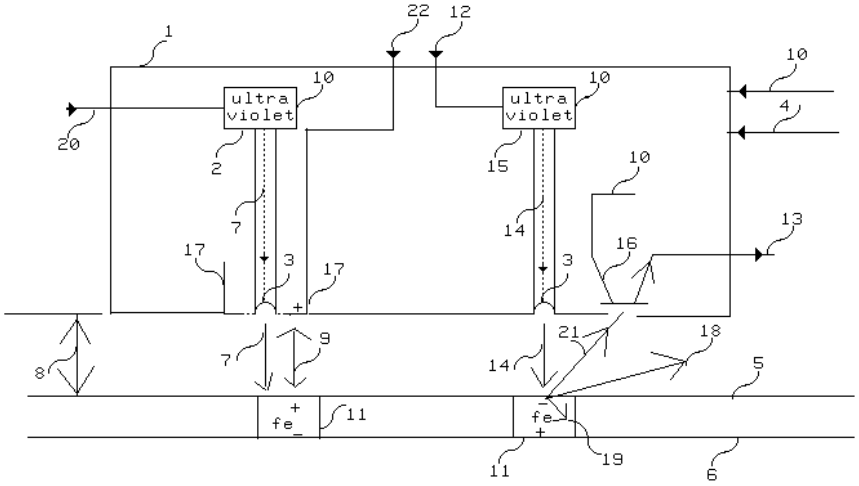


Fig. 2

reorientate the direction of the potential difference.[2] The dipoles electrical polarity of the ferroelectric molecule physically changes the transmiscivity, diffraction, surface morphology/topography, opacity, fluorescence, iridescence, opalescence and refraction characteristics of ultra-violet or deep blue light on the ferroelectric molecule. Extremely small laser spots of 300 angstroms and less can be written and read using integrated optical head structure with densities of 40 gigabits sq.in. to 40,000 Terabits a cubic centimeter being realized.

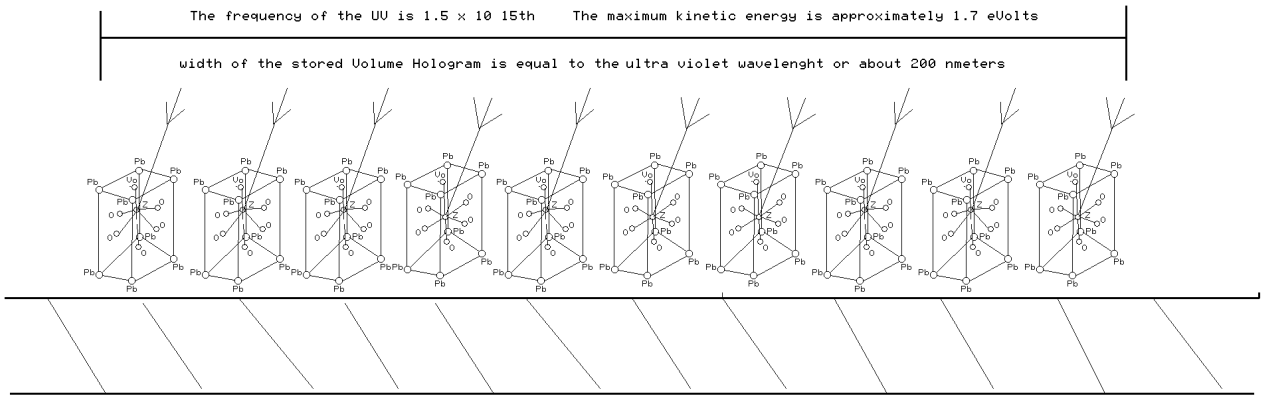


Fig. 3

SECOND METHOD FOR READING/WRITING TO FERROELCTRIC MOLECULE

Second method of reading is done by a floating gate mosfet transistor that is able to detect small changes in electric lines of force of the ferroelectric molecule Fig.4. The electrostatic field (electric lines of force) from the ferroelectric molecule is sensed by the read mosfet transistor.[8] The read voltage output is the recorded data in the ferroelectric molecule and is equal to the VCC of the floating mosfet transistor plus or minus the detected electrostatic field strength (electric lines of force) of the ferroelectric molecule. The read mosfet transistor is a source follower that does not destroy the stored electric field/voltage potential difference of the ferroelectric molecule Fig. 5. The read voltage output is the recorded data in the ferroelectric molecule and is equal to the VCC of the floating mosfet transistor plus or minus the detected electrostatic field strength (electric lines of force) of the ferroelectric molecule, i.e., 1.0v -/+ Xv = recorded data out Xv (v=voltage)(X=variable) voltage potential.[7] It is possible for the first time in history using Thomas's FE Head to write and read double sided disks, tapes, plate, film and drums having single or multiple layers of ferroelectric molecular media Fig. 6.

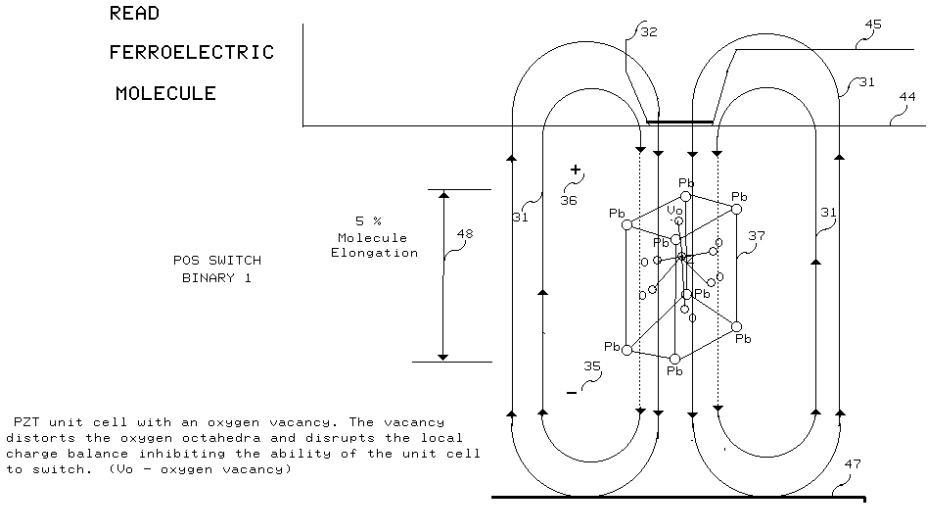
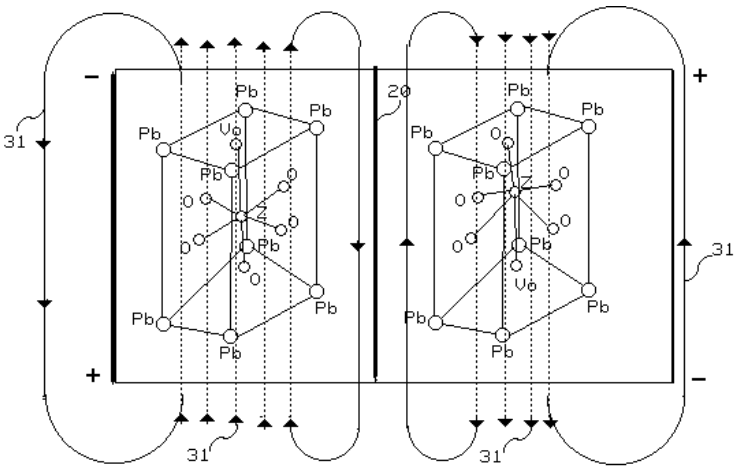


Fig. 4



PZT unit cell with an oxygen vacancy. The vacancy distorts the oxygen octahedra and disrupts the local charge balance inhibiting the ability of the unit cell to switch. (Vo – oxygen vacancy)

Fig. 5

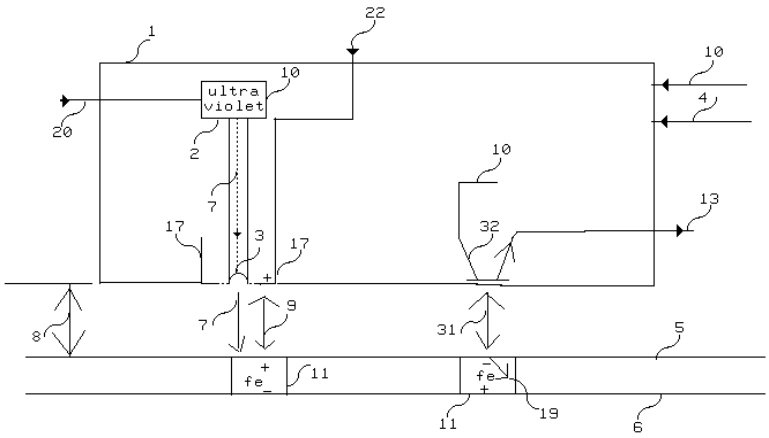


Fig. 6

THIRD METHOD OF READING/WRITING TO FERROELECTRIC MOLECULE

It has been shown that ferroelectric molecular write activity is influenced by the introduction of ultra-violet or deep blue light, Einstein/Planck theorem of Energy. An induced electrical field further alters the ferroelectric molecular properties such as conductivity and electrical properties. Removal of the light source and induced electric field leave the ferroelectric molecule in an altered electrical state potential which is non-volatile. Reading could be done by yet another interesting variable by a second deep blue or ultra-violet light source, which cause electrons of the ferroelectric perovskite molecule dipoles to jump from one orbit to another Fig. 7. Niels Bohr Atom Postulates states, light excited electrons will stay in their higher energy orbits, UV or deep blue light with specific frequency and quantum energy excite the electrons of ferroelectric molecules into higher valence orbits and fall back to the normal lower energy orbits when the UV or deep blue light source is removed. The stored internal dipole position (remnant displacement of central atoms - remnant polarization) further amplifies any higher orbit electron electrical field potential either positive or negative depending on the dipole position in the ferroelectric molecule and the distance from the UV or deep blue integrated read/write head. A Mosfet Nanotransistor that is able to detect small changes in the electrical field potential of the ferroelectric molecule when ultra-violet or deep blue light

source is focused on the ferroelectric perovskite molecule. Removal of the second UV light source (Quantum energy is characterized lower - not to induce electron movement into the conduction band) leaves the ferroelectric molecule in its initial electrical field stored state. New definition of terms includes light induced positive electrical fields, normal non-induced electrical field, and light induced negative electrical fields. The stored electrical field potential of a ferroelectric molecule can be made to represent at least four electrostatic field states equal to binary information. Double sided disk and tape can be produced by separating the ferroelectric molecular coating layer by a plastic, metal, glass, or ceramic substrate.

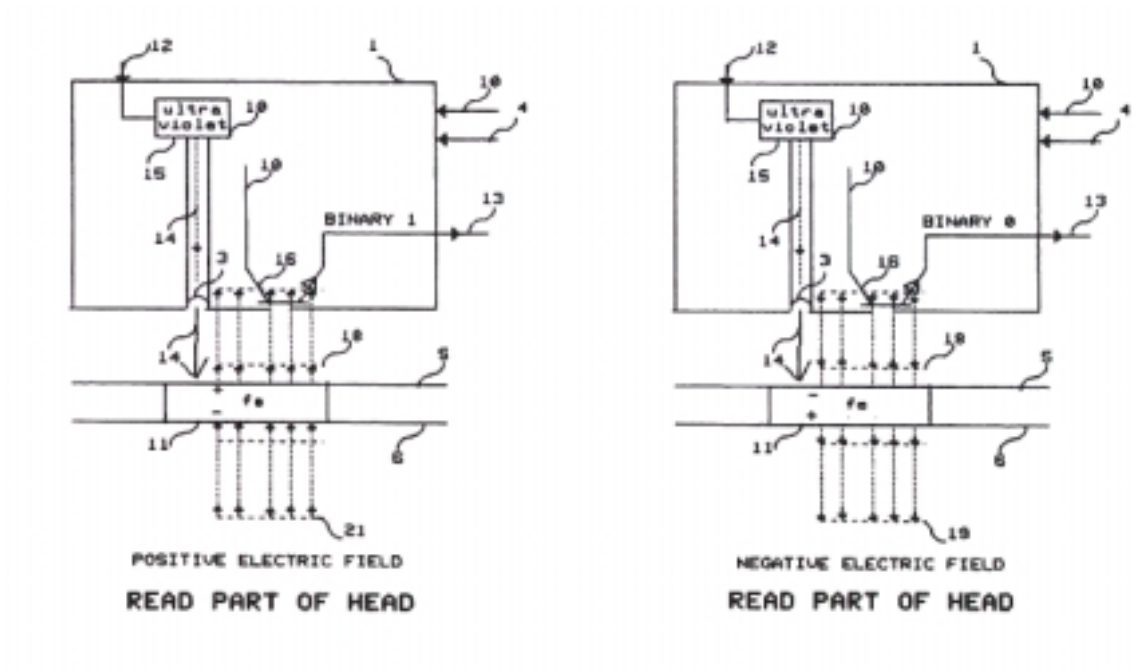


Fig.7

FOURTH METHOD FOR READING/WRITING 3 D VOLUME HOLOGRAPHIC

The method of reading/writing offers probably the highest potential of data storage by interference diffraction of light photons from the internal atoms of the molecule Fig 12,13. Thomas' patents on photon induced electric field poling allows for the writing of 3D volume data when read back having coherent interference waves in a beam of radiation at a single frequency causing a bright or dark band, caused by beams of light that are in phase or out of phase with one another due to diffraction by the bistable state nucleus in the center of ferroelectric molecule. The signal to noise ratios would be higher and the data transfer bandwidth theoretically capable of reaching over 40,000 Terabits/cu.cm. By using the internal dipole (2 electrical states - atomic switch) molecular structure of the ferroelectric molecule, Thomas' theory can offer a non destructive read from the dipole molecule Fig. 8. By reading the interference patterns (light and dark lines on the photo transistor or diode and comparing the patterns against systems stored hologram patterns extremely fast bandwidths of 100 gigabits and up can be easily achieved Fig 10,15. Writing to the molecule using UV laser source diode at 1x10 15^{th} hz and an data transfer electric field transducer at 10 gigahertz and higher is still non volatile with the addition of the second laser diode as an option for assisted writing power if necessary Fig 9,11,14,17. Reading of page stored data allows for reading of 400 molecules (data bits) per 200 nanometer UV photon spot or 50,800,000 bpi and track densities exceeding 25,000,000 tpi Fig 16.

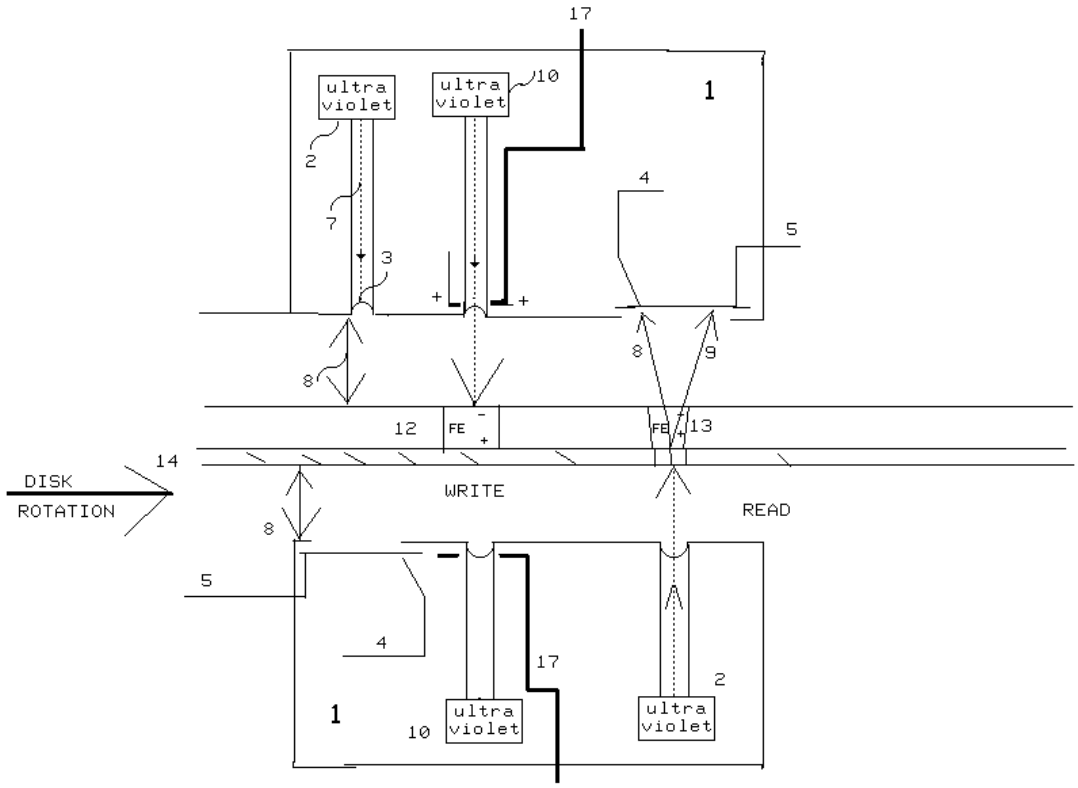


Fig. 8

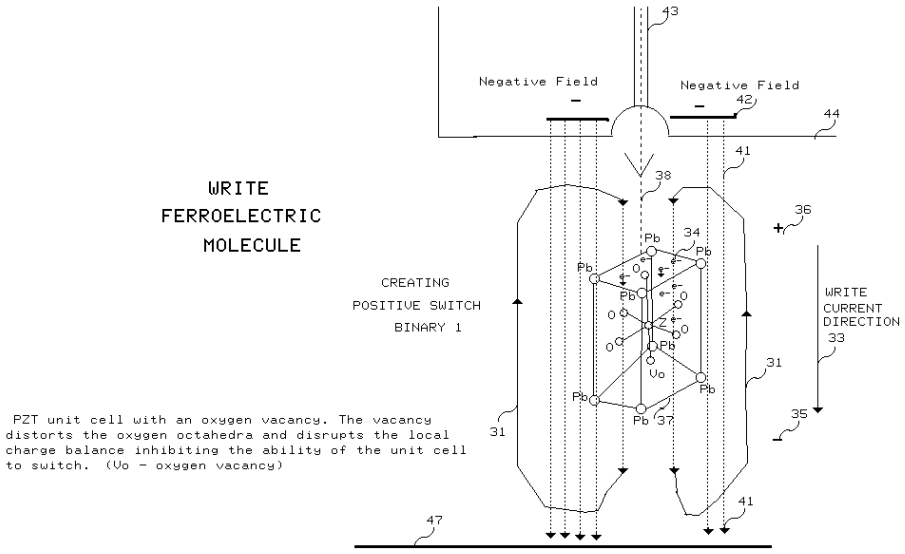


Fig. 9

The dipoles electrical polarity of the ferroelectric molecule physically changes the interference, diffraction, surface morphology/topography, opacity, fluorescence, iridescence, opalescence and Extremely small laser spots of 300 angstroms and less can be written and read using integrated optical head structure with densities of 40 gigabits sq.in. to over 40,000 Terabits cu. cm. being realized.

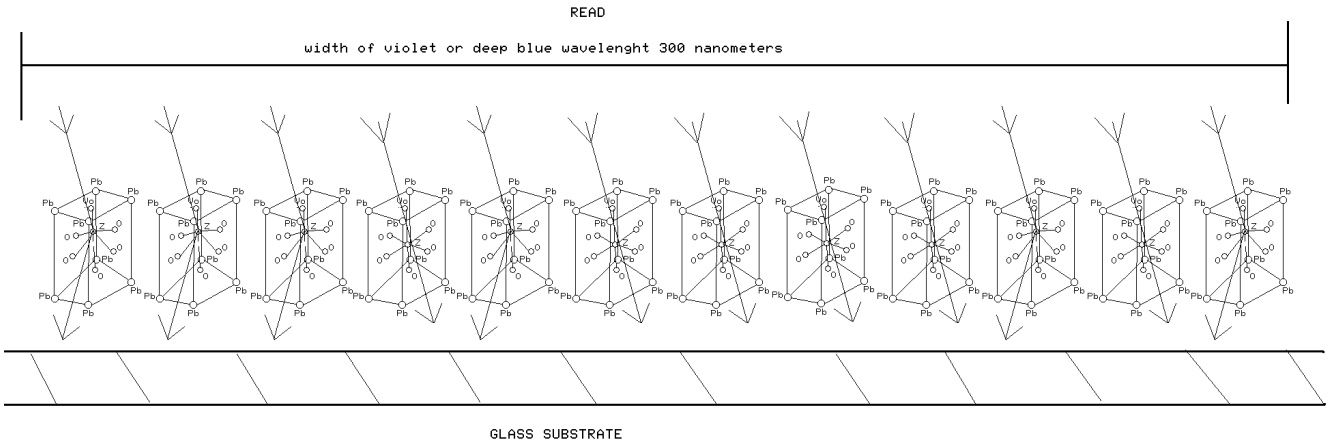
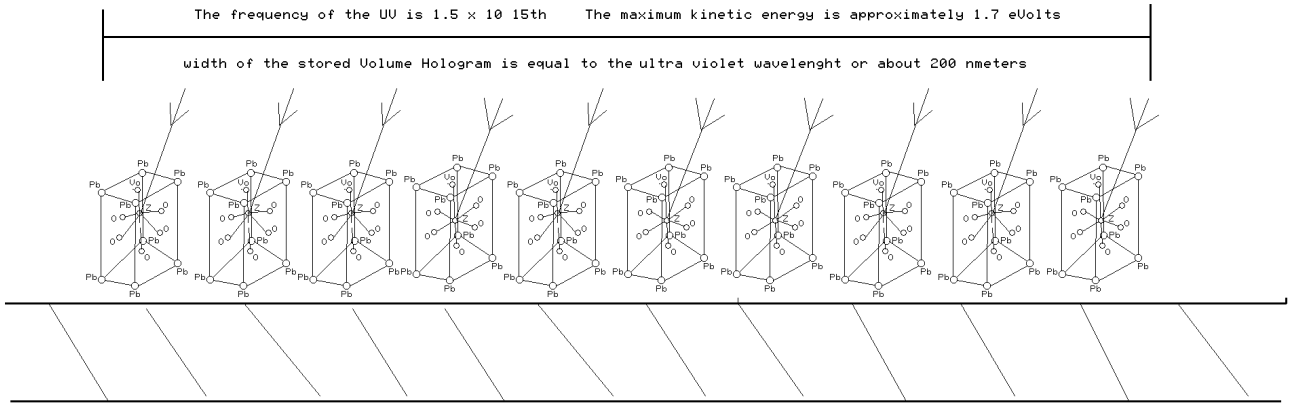


Fig. 10



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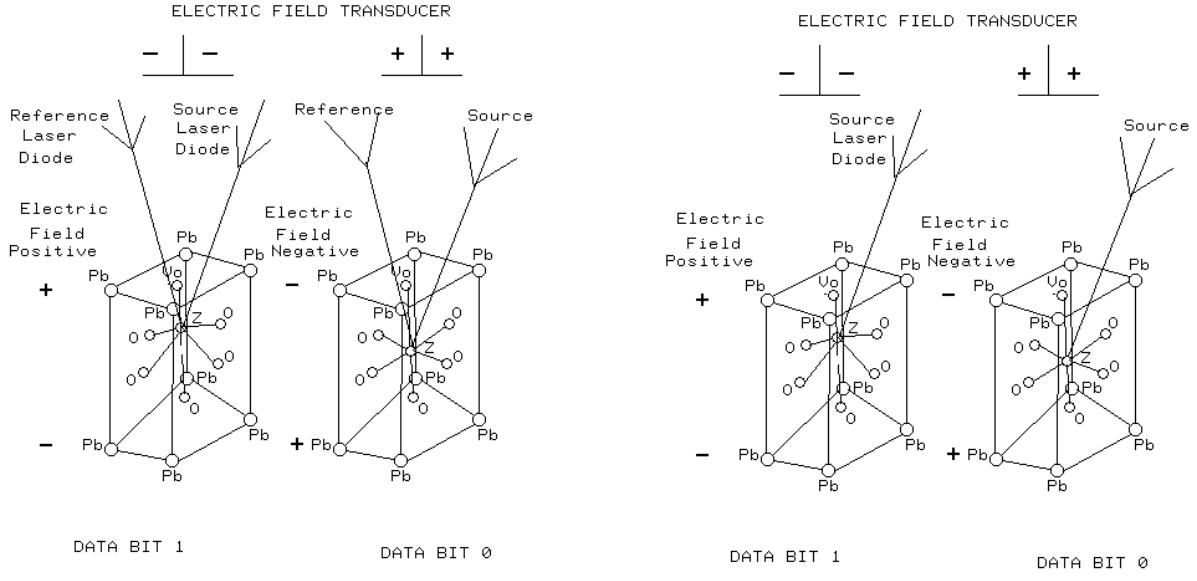


Fig. 12

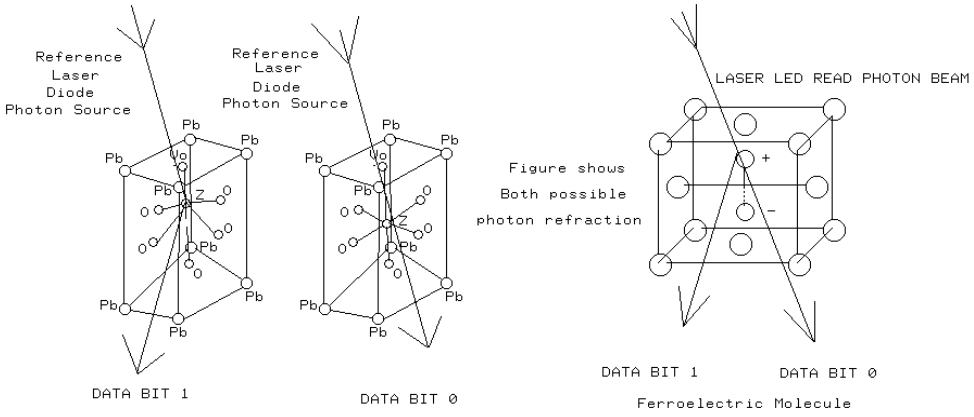
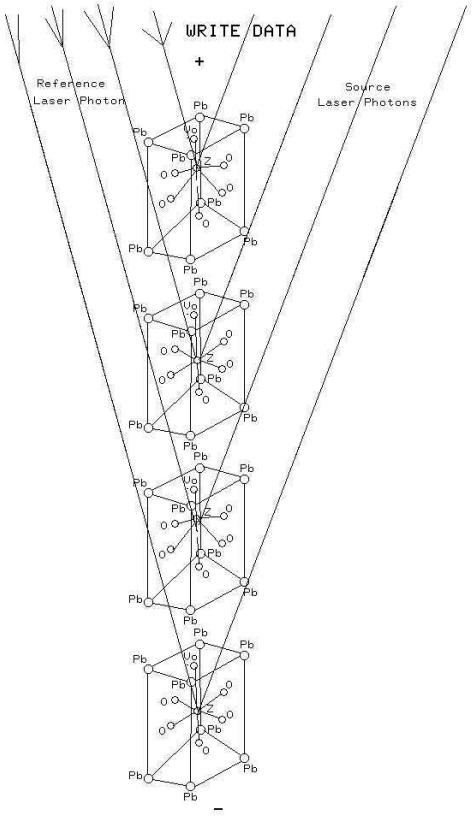


Fig.13



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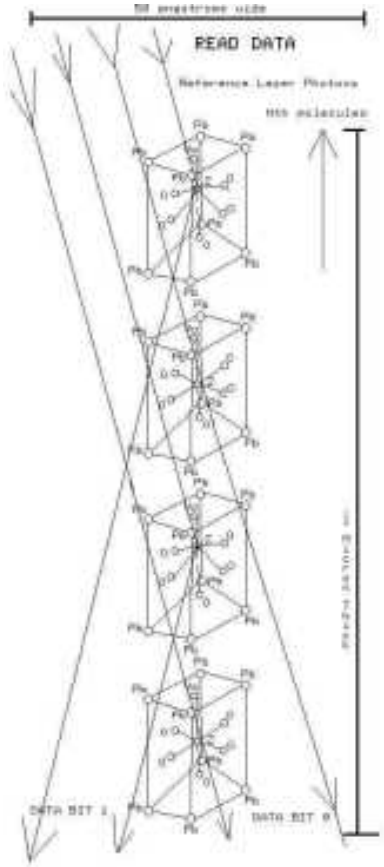

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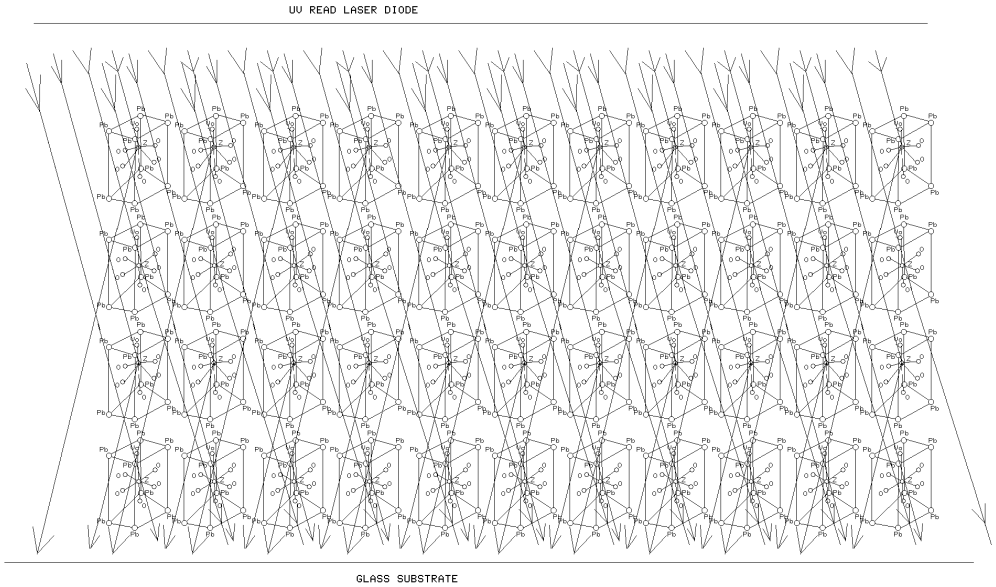

Fig. 16

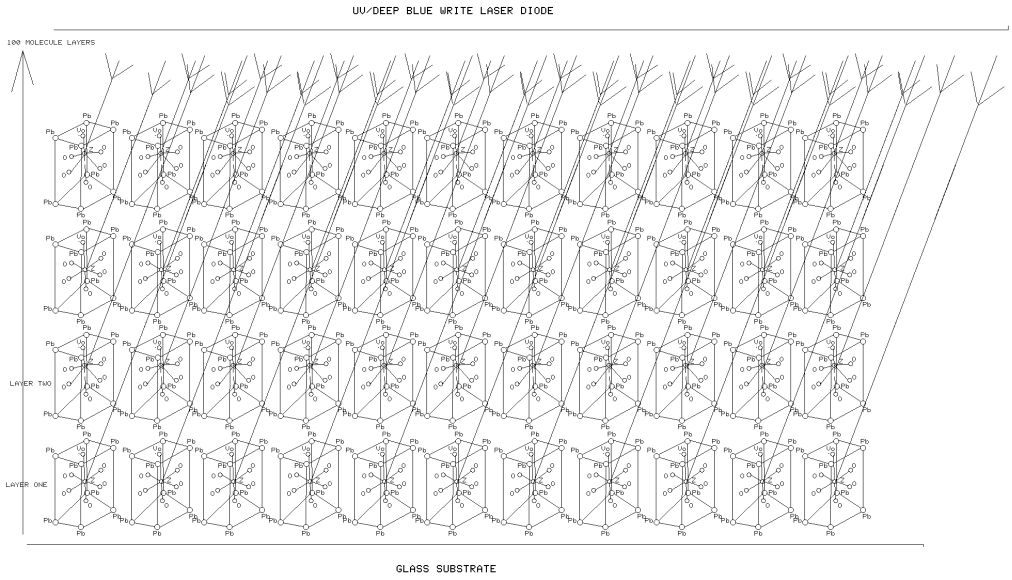

Fig. 17

Ferroelectric non-linear photonic bandgap crystals offer the possibility of controlling and manipulating light within a UV/Deep Blue frequency. The small size of ferroelectric transparent structures makes it possible to fabricate nano-optical devices like volume holographic storage having both positive and negative index of refraction.

The ability to control the diffraction of Ultraviolet photons makes the ferroelectric perovskite NLO photonic materials very attractive for the research and development of 3D volume holographic optical storage. Furthermore, ferroelectric non-linear photonic crystal structures provide the ability for infinite rewritablility of a non-volatile holographic storage drive.

The outstanding potentials of ferroelectric molecular materials will revolutionize 3D volume holographic optical storage technologies along with several challenges in design, optimization, fabrication, and characterization an provide for further extensive research and development activities in the field of ferroelectric holographic materials and data storage.

All other known attempts at rewritable holographic storage use electrons clouds to store data and as a result have only been able to achieve write once read many devices. Colossal feels this method can never overcome the Niels Bohr Atomic Theory of electron recapture and therefore this type of Bragg/Compton Scattering recording technique is usually destructive readout and a short data storage shelf life like spatial spectral hole technology.

All other holographic storage technology use a spatial light modulator (SLM) which writes one complete page of data at a time. The data must loaded serially to the SLM and is destructively written so any mistakes on the serial loaded SLM means increased wasted time. This method is great for WORM data storage but when BIT FOR BIT Erase / Write / and Read of random data to a disk is needed in real time day to day applications the SLM concept will NOT be able to function.

Colossal Storages method for writing / reading is like having billions of vertical spatial light modulated (SLM) pages in one rewritable ferroelectric track, each fedrive having almost a million tracks. Imagine having billions of SLM on the disk where the data is written / read in bit / byte / word accurately every time at atomic light speeds.

CONCLUSIONS

The future FE Atomic Holographic Optical Drive will offer symmetrical infinite double sided disk or tape non-destructive read and writes for the retention of data storage for 100 years or more with drive densities of 40,000 Terabits/cu.cm. and up. This will allow the holographic optical nanotechnology drive to hold more data than any other type of drive and deliver data much faster. The patents on a semiconductor read/write head for ferroelectric optical storage media memories promises to raise data storage densities by a factor of 100 or more and will add at least 1000 times the data storage capacity per peripheral storage footprint and data transfer rates over 100 Tbits/sec, Table 1.

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