Nanoscale transducer for writing and reading from protein-based storage media

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Due to the unprecedented thermal stability of the genetically engineered bacteriorhodopsin (Br), it is believed that the protein-based devices might become the data storage systems of choice as the areal densities go beyond 10 Tbit/in^2 mark. Developed Br mutants are nano-scale proteins that exhibit excellent physical and optical properties that make them ideal candidates for a storage materiali. The Br molecule has demonstrated a long-term stability with a shelf life of 10 years at room temperature. The Br media can be rewritten 10^6 times, one order of magnitude better than the state-of-the-art magnetic disks show today. The Br media has demonstrated a faster time response, as compared to the magnetic disks that makes the Br media superior with respect to the data rate. However, before the protein-based data storage can be finally implemented, the adequate mechanisms for writing and reading back information from this type of media should be investigated. The proposed mechanisms for recording and retrieving information from the Br medium are both optical. The proposed configuration of the recording system is similar to the configuration used in the recently proposed state-of-the-art hard-drives. In this implementation, the recording transducer consists of a semiconductor laser and a nanoscale photodetector both located at the air bearing surface. There are two advantages to locating the laser at the air bearing surface: 1) there is no need for a fiber to conduct light from the laser to the surface of the disk; 2) there is no need for a sophisticated and bulky light beam focusing system; and 3) the recording and retrieving is conducted in the near-field regime. During recording, a near-field light beam from a semiconductor laser locally exposes the disk. When Br absorbs light, it undergoes structural changes – it goes through a cascade of states. These states are the residues of the protein. The protein-based storage media has a strong potential to be developed into multi-level recording. During the playback process, the near-field light beam from the semiconductor laser locally exposes the disk at a much smaller power so that no structural changes in the protein occur. The amount of energy is detected by a nanoscale photodetector. The developed mechanisms will be tested using Guzik spinstand. The recording nanoscale transducers will be made with recently developed focused-ion-beam (FIB) rapid prototyping technology with support from Seagate Technology.

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