# MULTI-PHOTON EXCITATION OF NANOPARTICLES IN OPTICAL MICROSCOPY: BEYOND 3-D OPTICAL DATA STORAGE

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## 1. INTRODUCTION

Multi-photon excitation in an optical microscope has played an important role in high density optical data storage. The localised excitation feature associated with multi-photon excitation has allowed for the recording of multiple layers of data bits in a thick medium, which has a potential storage capacity of Terabytes per disk. This kind of three-dimensional (3D) optical data storage systems has been successfully demonstrated in many erasable and non-erasable polymer, crystal and glasss materials. Development of integrated photonic chips and super high resolution display devices compels the need for further expanding the current storage density by either breaking the diffraction limit of light or involving other physical dimensions. Here we introduce a new concept of multi-dimensional optical storage based on multi-photon excitation of nanostructured materials. In this new technology, the information can be stored not only in different positions of a thick medium but also in polarisation and spectral domains. The nanostructured materials comprise semiconductor nanocrystal quantum dots (QDs) and metallic nanorods. The tuneability of optical properties of the QDs and the plasmonic properties of anisotropic nanorods provide the various erasable and non-erasable polarisation and spectral encoding mechanisms in the same spatial position to break the data density limit imposed by the 3D optical storage technology. This nanophotonic approach will lead to a horizon of the new-generation optical data storage technology that is of a potential toward a data storage capacity of Petabytes.

## 2. EXOERIMENTAL

Fig. 1 shows the example of the QD-induced fluorescence energy transfer process under two-photon excitation, which is ready for polarisation multiplexing.

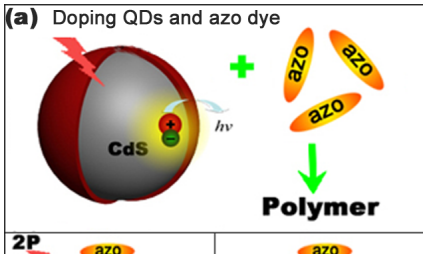


Fig.1 .Scheme of multi-dimensional optical data storage. a, Incorporation of CdS QDs and azo dye into polymer. b, 2P-excited FRET process. c, Consequent reorientation of molecules. d, Polarisation multiplexed multilayer optical data storage.

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