USE OF QUANTUM DOT NANOCRYSTALS FOR SPECTRALLY ENCODED OPTICAL DATA STORAGE

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Abstract -- *In this paper, we demonstrate the spectral encoding capability of quantum dot nanocrystals (QDs). We mixed two different sizes of QDs in a resin, and two-photon excitation at various wavelengths showed that the relative intensities of the fluorescence from two QDs varied significantly. Such a difference in level of absorption at different wavelengths allows one to record information only on one size of QDs, without affecting the other sized QDs. This property can be applied to optical data storage, so that storage density can be greatly improved.*

Recently, three-dimensional (3-D) optical storage has been receiving much attention due to its ability to overcome the current two-dimensional optical storage capacity limit imposed by the diffraction limit of light [1]. However, due to the problems of aberration and scattering of recording beam inside the medium, it is likely that the 3-D optical storage technique will quickly hit its capacity limit. One possible way of overcoming this issue is by incorporating other physical dimensions, which are not in spatial domain, into 3-D optical storage. In this paper, we demonstrate spectrally encoded optical data storage by using quantum dot nanocrystals (QDs).

The QDs have received so much attention because of their interesting properties such as emission wavelength tunability with size, narrow emission bandwidths and discrete atom-like energy level structures [2]. In particular, the discrete energy level structure permits their fluorescence intensities to vary with an excitation wavelength [2]. When two different sizes of QDs are mixed, the differences in energy level structures can be manifested by variation in relative intensities of the two fluorescence wavelengths with respect to the excitation wavelengths. This is shown in Figure 1, where the fluorescence spectrum of green QDs (~ 3 nm in diameter) mixed together with red QDs (~ 6 nm diameter) are shown, excited by various near-infrared wavelengths (two-photon absorption). The peak intensities of two QDs are plotted against the excitation wavelengths, shown in Figure 1b. The two-photon absorption of the QDs is proved in a log-log plot of the fluorescence intensity with respect to the input power, which is shown in Figure 1c. The figures show that at certain wavelengths, each coloured QD shows increased absorption, and therefore more interactions with excitation light such as bleaching or quenching are expected [3]. Such properties can be further utilized in optical storage, where marks can be recorded on one type of QDs at a certain wavelength without affecting the other QDs. In the talk, further development of the QD based spectral encoding will be presented.

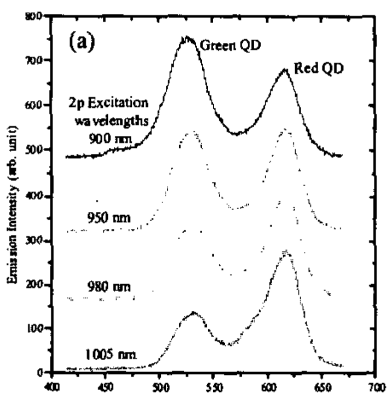
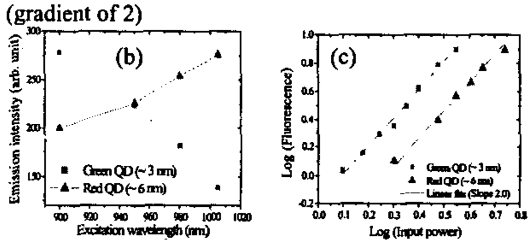


Figure 1. (a) Two-photon fluorescence spectrum of mixed QDs in resin at difference excitation wavelength. Note the relative change in intensities of two QDs. (b) Fluorescence peak intensities of QDs are plotted against excitation wavelengths. (c) Two-photon absorption of QDs are confirmed by the log-log plot (gradient of 2)



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0-7803-7766-4/03/$17.00 ©2003 IEEE