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Optical Memory with Ultra-High Data Density by Multi Layered PHB (Photochemical Hole Burning) System

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PHB(Photochemical Hole Burning) has a possibility to offer us an optical memory with ultra-high data density of more than 10^{11}bits/cm^2 theoretically. Such high data density can be achieved by multiplexing the information in the additional frequency dimension besides the x-y spatial domain. The multiplexing of the information is realized by burning a sequence of narrow spectral holes as signals in the spectrum of a PHB material as shown in Fig.1. We have attempted to offer an optical memory with ultra-high data density by using not only a PHB material but also layered PHB materials. We report here the successful result of multiplexing the information by a factor of more than 600 which is equivalent to more than 600 times of today's optical memory density limitation and the highest data density ever reported in the world.

As PHB materials, we have found out two material systems such as 1,4-dihydroxyanthraquinone (DAQ) / poly-2-hydroxyethyl methacrylate (PHEMA) and 4-amino-2,6-bis(4-butylphenoxy)-1,5-dihydroxyanthraquinone (ABDAQ) / PHEMA. The samples were prepared in the form of polymer film of PHEMA containing DAQ or ABDAQ dilutely (10^{-4} to 10^{-5} mol/mol). The sample was set in the cryostat controlled at 4.2K. The tunable dye-laser was used to cause the PHB reaction and produce holes in the spectrum. The spectra to detect the holes were measured with the monochromatized light and a photomultiplier.

It was found firstly that the PHB reaction can be caused efficiently in the spectral ranges of 560 to 585 nm in the DAQ/PHEMA and 580 to 605 nm in the ABDAQ/PHEMA system,respectively. Then we examined the PHB reaction in a double layered PHB system by piling the DAQ/PHEMA onto the ABDAQ/PHEMA system as shown in Fig.2. The laser beam was irradiated from the DAQ/PHEMA to the ABDAQ/PHEMA layer. As shown in Fig.3, we have successfully caused the PHB reaction and produced more than 600 spectral holes without any interference between two layers only in the spectral range of 565 to 601.5 nm for the first time in the world in the double layered PHB system. This result is equivalent to that the information can be multiplexed by a factor of more than 600 and the data density can be more than 6×10^{10}bits/cm^2 far beyond the one of the today's optical memory (10^8 bits/cm^2) and also our previous result by PHB[1] (10^{10}bits/cm^2). This work was conducted under a program set by the agency of Industrial Science and Technology.

1) M.Yoshimura et al., Chem.Phys.Lett.,143(4)342(1988).

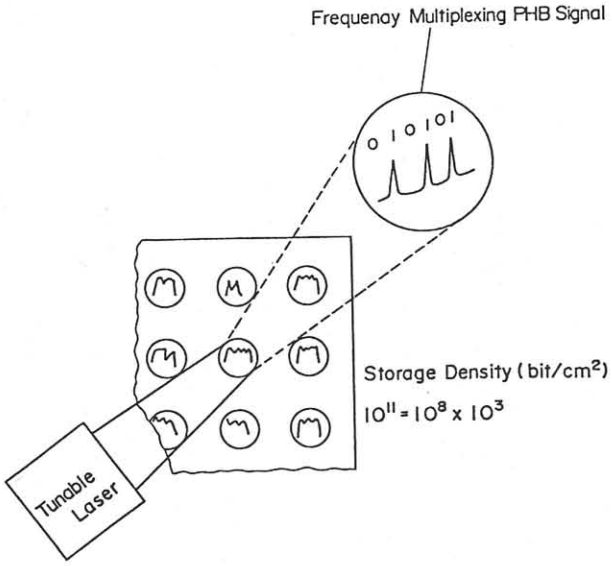

Fig. 1 Principle of Multiplexing of Information by PHB.

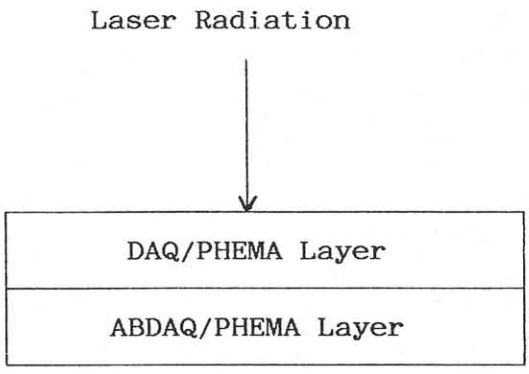

Fig. 2 Double Layered PHB System.

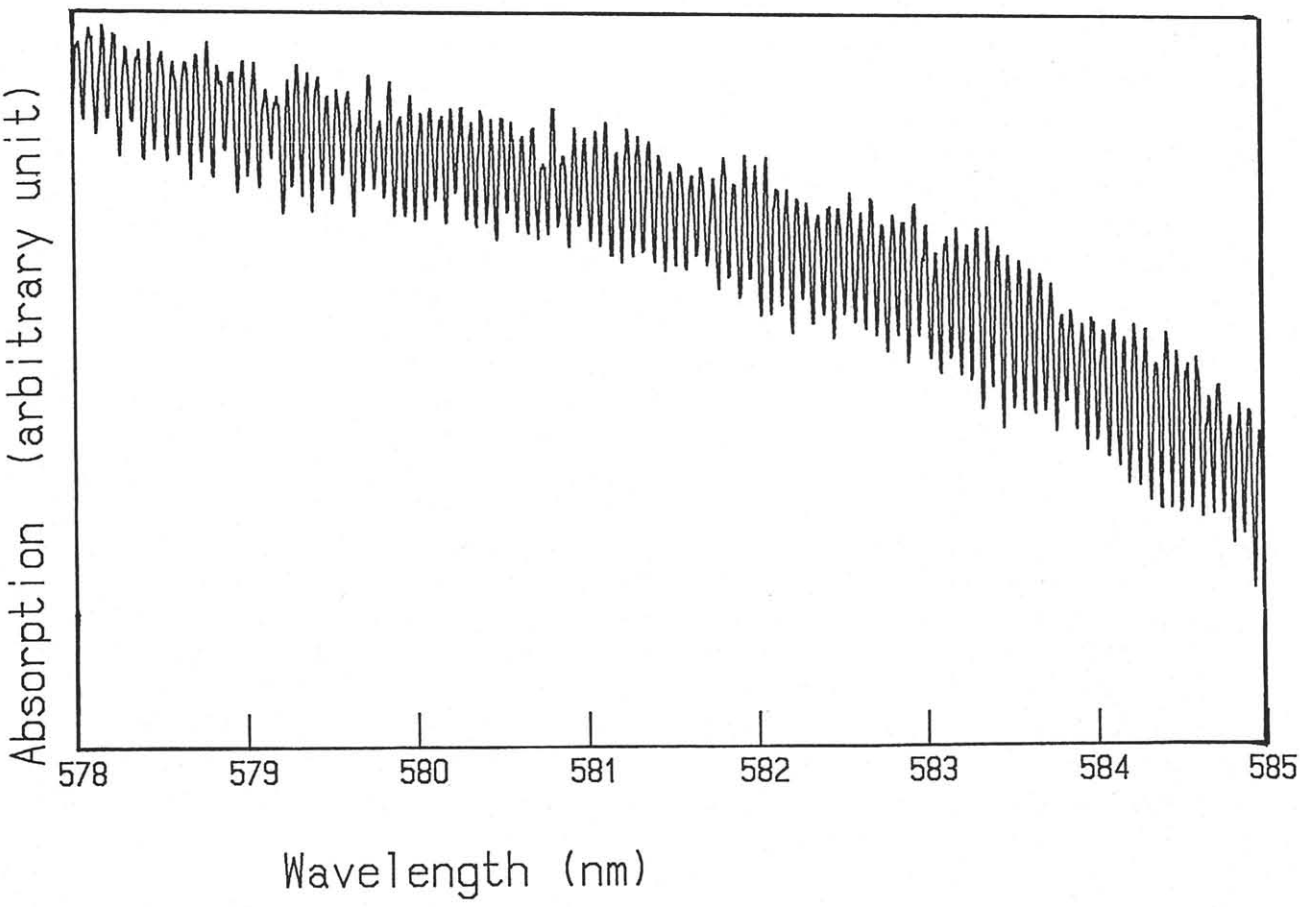

Fig. 3 Hole Multiplexing in Double Layered PHB System.
(This is a partial one of the whole hole multiplexing which will be shown on the day of presentation.)