Functional Materials 10, No.4 (2003)

On dynamics of photoinduced processes in three-layer Ag–PbI_2-chalcogenide semiconductor systems

V.V.Mussil, Ye.T.Lemeshevskaya, V.V.Pilipenko, A.P.Ovcharenko[*]

National Technical University "Kharkiv Polytechnic Institute",
21 Frunze St., 61002 Kharkiv, Ukraine
[*]V.Karazin Kharkiv National University,
4 Svobody Sq., 61077 Kharkiv, Ukraine

Received December 15, 2002

Photoinduced changes of optical transmission in three-layer system Ag/PbI_2/Ge–As(P)–S chalkogenide semiconductor have been investigated. Effects of chemical composition effect and laser irradiation conditions on photoinduced processes in the systems have been studied. The optical spectra have been shown to change reversibly under alternate illumination by light from their absorption and transparence regions. Time dependences of transmission changes have been considered taking into account photoinduced silver diffusion into PbI_2 and the chalcogenide semiconductor, metal particle formation and destruction in the PbI_2 layer, and processes at the PbI_2-chalcogenide semiconductor boundary.

Исследованы фотоиндуцированные изменения оптического пропускания в трехслойных системах Ag/PbI_2/халькогенидный полупроводник Ge–As(P)–S. Изучено влияние химического состава полупроводника и условий лазерного воздействия на фотоиндуцированные процессы в системах. Показано, что оптические спектры изменяются обратимо при попеременном облучении образцов светом с длинами волн из области их поглощения и прозрачности. Временные зависимости изменения пропускания проанализированы с учетом фотоиндуцированной диффузии серебра в PbI_2 и халькогенидный полупроводник, образования и разрушения частиц металла в слое PbI_2, процессов на границе PbI_2-халькогенидный полупроводник.

Thin films of glassy semiconducting materials are known to be used for reversible optical data recording [1, 2]. The image so obtained can be erased either by the film heating up to temperature close to softening point of the initial glass or by high-intensity laser irradiation of the exposed area. The record-erasing cycle duration in such reversible media is as short as several fractions of second. The response speed as well as the photosensitivity and the image contrast can be improved substantially by insertion of the semiconducting photosensitive layer into a multilayer system like to a narrow-band interference filter [3]. Due to action of a highly absorbable radiation and of that from the relative transparence region of the semiconducting layer, the structure optical characteristics are changed reversibly at the cycle duration of the order of milliseconds.

The cyclic recording regime can be realized in metal-chalcogenide semiconductor two-layer systems including a polycrystalline PbI_2 interlayer [4, 5]. In the film structures of that type, photostimulated processes of the metal diffusion, formation and destruction of thin metal particles in the PbI_2 layer, and diffraction periodical structure formation in the amorphous semiconductor layer take place. Those processes result in reversible changes of optical spectra