

Nonequilibrium charge relaxation processes in the barrier zone of nonideal heterojunctions

V.A.Borschak

I.Mechnikov Odesa National University,
2 Dvoryanskaya St., 65026 Odesa, Ukraine

The signal relaxation processes in a nonideal heterojunction based sensor have been studied. Such a sensor is capable of a rather long-term storage of a latent image even at room temperature, since the image is formed by the nonequilibrium charge stored at deep traps in the space-charge region where a considerable recombination barrier is present. The signal relaxation after the exciting light switching-off was studied in four points of the sensor. The signal has been found to decrease at the same characteristic relaxation time but to differ considerably in absolute value at different points. This fact evidences that the sensor photosensitivity unhomogeneity is caused by substantial variation of the trapping center concentration over the surface, the parameters defining the thermal emission probability being the same.

Исследованы процессы релаксации сигнала в сенсоре на основе неидеального гетероперехода. Такой сенсор даже при комнатной температуре может достаточно долго хранить скрытое изображение, так как оно сформировано неравновесным зарядом, захваченным на глубокие ловушки в области пространственного заряда, где имеется значительный рекомбинационный барьер. Исследование релаксации сигнала после выключения возбуждающего света было выполнено в четырех точках сенсора. Установлено, что в разных точках сигнал убывает с одним и тем же характерным временем релаксации, однако сильно отличается по абсолютной величине. Это свидетельствует о том, что неоднородность фоточувствительности сенсора вызвана существенным изменением вдоль поверхности концентрации ловушечных центров с одними и теми же параметрами, определяющими вероятность термического выброса.

A nonideal heterojunction is known to be in equilibrium and nonequilibrium states [1, 2]. In the first-mentioned one, it has a low sensitivity to IR light and, respectively, a low short-circuit current value (I_{sc}) while the nonequilibrium state is high-sensitive to IR light and is characterized by a high I_{sc} . The transition from the equilibrium state to the nonequilibrium one occurs under short-wavelength light due to trapping and accumulation of the nonequilibrium photogenerated charge at deep trapping centers in the space-charge region (SCR) of the nonideal heterojunction. After the exciting irradiation is over, the system returns of course to the equilibrium state sooner or later. The relaxation time defines obviously the data storage duration in an optical sensor based on a nonideal heterojunction as well as the

possibility to accumulate the signal under prolonged exposures by weak light, thus, it defines actually the maximum sensitivity of the sensor under study. Thus, a detailed study of the emission processes of the charge trapped in the SCR as well as of effects of external factors (temperature, bias, etc.) on those processes is of importance.

It has been found in experiment that a sensor based on a nonideal heterojunction is capable of a rather long-term storage of a latent image even at room temperature, since the image is formed by the nonequilibrium charge stored at deep traps in the space-charge region where a considerable recombination barrier is present that hinders the recombination of the trapped charge with free carriers. Nevertheless, the relaxation of the nonequilibrium charge occurs in