non-planar interface between adjacent domains. DW is a three-dimensional structured element of finite extent of the domain of the array with a nonuniform distribution of the magnetization vector in them as in thickness, and developed the film plane. The structure of the DW uniaxial films, such a study, is referred to as the twisted type, i.e. is neither Bloch nor Neel. In our experiments, the external magnetic field is applied in the film plane perpendicular to the easy axis (EA) and the DW motion in a magnetic field when it is not. Probably, in the magnetic field changes occur in the structure of the twisted DW and change the ratio in the initial balance between Bloch and Neel components. The magnetization of the wall with increasing magnetic field deviates more and more from the Bloch orientation, i.e. there is a certain structural "imbalance". At the same time, structural changes in the domain heads led to the fact that they were more susceptible to the influence of an external electric field (which changes the parameters of the magnetic anisotropy of the film), oriented parallel to the normal to the sample surface as compared with the more direct, the length of the labyrinth of the DW. The question about the local response of individual sections of the DW to an external electric field, more research is needed.

Conclusions. Thus, our results of imaging studies of magneto-electric interaction manifestations in FG/GGG epitaxial structures with typical maze domain structure showed the following. A very small impact on the value of the joint action of alternating and static electric fields on the domain wall is shown only when the additional connection of a static magnetic field, oriented in the plane of the sample. Visually observed a small effect of the local "smearing" of individual sections of the domain wall can be seen, probably, as a small distortion of the DW profile without DW displacement as a whole.

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Submitted on 30.09.14

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ВІЗУАЛІЗАЦІЯ МАГНІТОЕЛЕКТРИЧНИХ ПРОЯВІВ У ЕПІТАКСІЙНИХ СТРУКТУРАХ ФГ/ГГГ

Використовуючи метод поляризаційної мікроскопії, в умовах одночасного впливу постійного і змінного електричних полів і магнітного поля, досліджувалась реакція доменної структури (ДС) епітаксійних плівок феритових гранатів (ФГ), вирощених на підкладинках з галлій-гадолінієвого гранату (ФГ/ГГГ). У прохідному світлі, візуально виявлено малий ефект "розмиття" профілю окремих локальних ділянок доменних меж (ДМ) плівок в умовах комбінованого трьохканального впливу.

Ключові слова: *магніто-електричний ефект, електричне поле, магнітне поле, доменні межі, доменна структура, поляризаційний мікроскоп.*

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ВИЗУАЛИЗАЦИЯ МАГНИТОЭЛЕКТРИЧЕСКИХ ПРОЯВЛЕНИЙ В ЭПИТАКСИАЛЬНЫХ СТРУКТУРАХ ФГ/ГГГ

Используя метод поляризационной микроскопии, в условиях совместного воздействия постоянного и переменного электрических полей и магнитного поля, исследовалась реакция доменной структуры (ДС) эпитаксиальных пленок ферритовых гранатов (ФГ), выращенных на монокристаллических подложках из галлий-гадолиниевого граната (ФГ/ГГГ). В проходящем свете, визуально обнаружен малый эффект "размытия" профиля отдельных локальных участков доменных границ (ДГ) пленок в условиях комбинированного трехканального внешнего воздействия.

Ключевые слова: *магнито-электрический эффект, электрическое поле, магнитное поле, доменные границы, доменная структура, поляризационный микроскоп*

UDC 53; 547.136.13; 576.535; 577.037

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EVALUATION OF DOSE DISTRIBUTION IN PENUMBRA AREA BY USING LIDHT EMITTING STRUCTURES

A light-emitting diodes possess some essential advantages, compared to all other sources of previous generations, such as low energy consumption, small size, high operating speed, reliability. Dosimetry of radiation field in the penumbra area must be carried out with sensor of minimal size and maximal sensitivity. Gallium phosphide light emitting diode of less than 1mm^2 size. It is appropriate to use LEDs due to their low cost and emitting ability in visible region of spectrum.

Keywords: *gallium phosphide, penumbra, LEDs, light-emitting diodes, dosimetry, spectra.*

Introduction. Modern light emitting sources are the special types of high spectral purity illuminators useful in wide spectral range (from infrared to ultraviolet light). The devices possess some essential advantages, compared to all other sources of previous generations, such as low energy consumption, small size, high operating speed, reliability and low cost. The scope of these devices is constantly expanding: precision instrumentation, production of household appliances, and also medicine.

Gallium phosphide, the wide-zone semiconductor of $A^{III}B^{V}$ group, due to simple and inexpensive technologies allows creating p-n- transition by growing epitaxial films and doping them chemically. The doping of material by isoelectronic (concerning phosphorus) nitrogen impurity causes an appearing of electron traps. A negatively charge center attracts a free hole and form Vanye-Mott exciton of a large radius. The level of its ground state is Ec-0,20 meV, which makes it possible at essential excitation to observe emitting even at room temperature (green narrow band with hv =2.10 eV).

Simultaneous doping of GaP crystal by zinc and oxygen forms analogous emitting center. At sufficient doping levels of both atoms, zinc and oxygen as isovalence impurities in gallium and phosphorus sublattices accordingly, are situated nearby and due to the lattice deformation form exciton traps. Annihilation of an exciton, bound to Zn-O pair, causes emitting in the red range of the spectrum (hv =1.80 Ev) [3–4].

Experiment. Emitting spectra of p-n structures of both doping types (at room temperature) are given in figures 1–2. From the dependence of the emitting intensity on the current through the transition it is possible to adjust device brightness by changing the level of injection of minority carriers.

Irradiation of GaP LEDs leads to monotonic decrease in the intensity of luminescence due to stable at room temperature phosphorus and gallium vacancies of annealing activation energies of 1.5 and 2.0 eV, respectively. The center of annealing stage of Vp is $150 \div 160^{0}$ C, and V_{Ga} – $250 \div 270\ ^{O}C$, that provides the thermal stability of the accumulated information .

We studied diodes irradiated with 2 MeV electrons and had shown that dose dependences of emitting brightness at different currents had the form of monotonic curves; at low doses ($\Phi<10^{14}$ cm^{-2}) they were nearly linear (Figure 3).

Discussion. It is known that forming of dose field of complex configuration on the body of the patient is performed with the help of system of wedges and bolus of specific profile. Owing to the particles' diffraction and the source size influence the penumbra effect inevitably appears which evokes the overexposure of the healthy tissue.

The problem of protection has become especially alert, if critical organ is situated near irradiation zone.

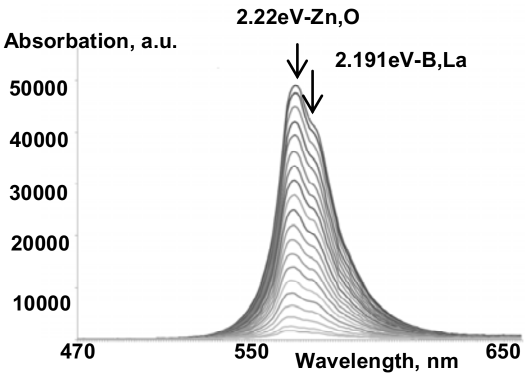

Fig. 1. Emitting spectra of green LED at different currents through p-n –transition at room

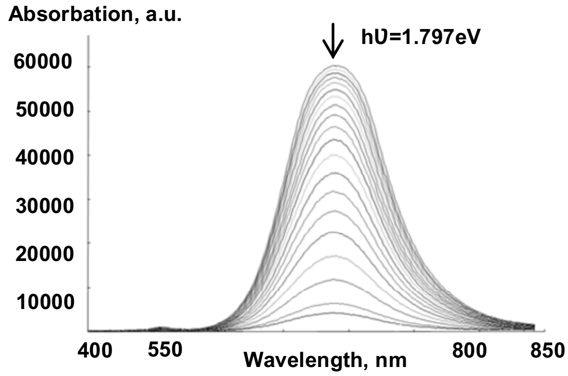

Fig. 2. Emitting spectra of red LED at different currents through p-n –transition at room temperature

Radiobiological effect is known to have two stages. At the first stage interaction of penetrating radiation with a cell is rapid and is accompanied by visible changes. Further morphological and functional effects can appear in a few minutes or even a few years after exposure.

To this day the effect of small doses in humans still remains unclear. Therefore, the problem of accurate dosimetry is closely associated with the prediction of the impact of long-term effects of radiation on the patient's health in the future and also with the dose circumscription in the critical organs.

Accurate assessment of the effects of radiation in biological object with active repair damages and opposite action of cumulative effect is possible only with high quality dosimetry measurements.

In passing, it should be noted that the function of cell survival varies exponentially with the dose, confirming the importance of accurate determination of this parameter. In beam radiotherapy the problem of beam's coupling is one of the most difficult. It is in this case an important role of a minimal source size and its high sensitivity.

It is advisable also to mention the method of photodynamic therapy, which is based on photochemical reactions in the dye, previously introduced into the tumor. The products of decomposition of the dye in the light cause the destruction of oncology cell.

A special technique monitors the level of accumulation in cells sensitizer, then the tumor is illuminated by the source of a certain wavelength.

Modern LEDs unlike lasers cover almost continuously the entire visible region of the spectrum, including infrared and ultraviolet light, and being introduced into the tumor, can provide the process of photochemical cytotoxic reactions with the formation of singlet oxygen and subsequent destruction of diseased cells.

The main purpose of our research is to offer a method and using of gallium phosphide p-n- transition in radiation medicine practice in order to measure the tissue-absorbed doses.

Dosimetry of radiation field in the penumbra must be carried out by the sensor of minimal size and maximal sensitivity. Light emitting diode of less than $1mm^2$ size and high penetrating radiation sensitivity provided by exciton recombination mechanism, in our opinion, fits the best. It is appropriative to use gallium phosphide LEDs due to their low cost and emitting ability in visible region of spectrum.

Dose dependence of GaP LED's emitting intensity, carried out during irradiation by electrons with E = 2 MeV, is linear to the $5x10^{14}$ cm^{-2} , which can be useful for the dosimeter of especially small doses.

In order to build the dosimetric map one needs some samples with similar output emitting intensity. One of them had to be previously graded at the accelerator, which henceforth will be used in clinical practice. Experience suggests that change of emitting intensity of proposed diode owing to irradiation should be monitored by the simple silicon photocell without stationary spectrometry equipment.

For this purpose the lightproof camera is designed connected to regulated source of LED's supply and photocell setting-up. The tissue absorbed dose is evaluated based on the known values of the weighting factors for its and for the beam.

In order to restore the diode emitting intensity after the first dose one should increase the current through the diode.

An advantage of the proposed dosimetry method is the ability to process information "on line" during target irradiation as well as during adjustment of irradiation outfit.

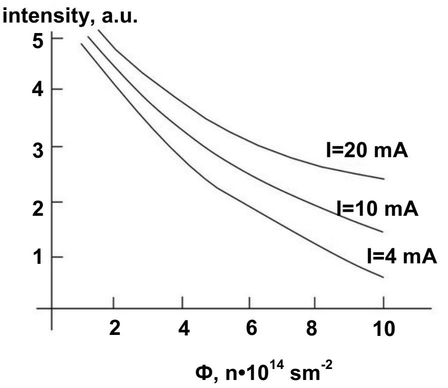

Fig. 3. Dose dependences of emitting intensity of red LED irradiated with 2 MeV electrons at different currents through p-n –transition at room temperature

For example, in order to input sensor into area of the inner cavity of the body, one can use the cable system of the hard radiation source supply, used in brochytherapy, while replacing the radioactive preparation by the LED. Then during external wide field gamma-irradiation the change of luminescence intensity of diode responds the quanta fluence in a particular dot area of the target. In the case the optoelectronic pair serves as the sensor, than the dynamics of irradiation process can be recorded electronically.

The accuracy of location of apparatus with the sensor can be controlled by means of X-ray television.

Conclusions. Electroluminescent dosimeter is particularly useful in modeling of proton irradiation or its planning in tissue-equivalent phantom. In this method the accuracy to determine the Bragg peak position is of the great importance. So when several of LED sensors are placed in the controled area, the location of the diode with a maximum level of degradation is the localization of the Bragg peak.

In multiple-field irradiation the proposed method can help to combine the Bragg peaks of different beams on the same target.

Note also that the GaP sensors allow storing information at room temperature for a long time, as the minimum temperature of radiation defects' recovery in this material is 150^0 C [1–2].

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Submitted on 09.11.14

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ОЦІНКА ДОЗОВОГО РОЗПОДІЛУ В ОБЛАСТІ ПЕНУМБРИ З ВИКОРИСТАННЯМ СВІТЛОДІОДНИХ СТРУКТУР

Світлодіоди володіють деякими істотними перевагами порівняно з усіма іншими видами джерел попередніх поколінь. Світлодіодним структурам властиві – низька енергоємність, мініатюрність, швидкодія, надійність. Дозиметрія радіаційного поля у межах напівтіні повинна здійснюватися датчиком мінімального розміру та максимальної чутливості. Саме таким елементом може бути структура розміром менше 1мм². З нашого погляду найдоцільнішим є використання епітаксіальних фосфід- галієвих p-n-переходів з огляду на їхню низьку вартість та випромінювання у видимій області спектру.

Ключові слова: *фосфід галію, напівтінь, світлодіоди, дозиметрія, спектр.*

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ОЦЕНКА ДОЗОВОГО РАСПРЕДЕЛЕНИЯ В ОБЛАСТИ ПЕНУМБРЫ С ИСПОЛЬЗОВАНИЕМ СВЕТОДИОДНЫХ СТРУКТУР

Светодиоды обладают некоторыми существенными преимуществами по сравнению со всеми другими видами источников предыдущих поколений. Светодиодным структурам присущи – низкая энергоемкость, миниатюрность, быстродействие, надежность. Дозиметрия радиационного поля в пределах полутени должна осуществляться датчиком минимального размера и максимальной чувствительности. Именно таким элементом может быть структура размером менее 1мм². С нашей точки зрения наиболее целесообразным является использование эпитаксиальных фосфид- галлиевых p-n-переходов, учитывая их низкую стоимость и излучения в видимой области спектра.

Ключевые слова: *фосфид галлия, полутень, светодиоды, дозиметрия, спектр.*