THE CONTROL OF A DOSE OF RADIATION OVER USE OF GLASS OPTICAL FIBER WAVEGUIDES

E.K. Mamedov

Azerbaijan National Academy of Science, Institute of Radiation Problems, AZ 1143

ABSTRACT

In radiating physics, chemisry, medicine, the nuclear industry, radiating technology, etc., there is a necessity of measurement of doses radiations in extremely wide range of their values. So for example, in radiating physics, chemistry and radiating technology rather big doses in an interval ~ $10 \div 10^{8}$ Gy are used , where as in dosimetry of the person where it is necessary to deal with questions biological protection, small doses in a range ~$10^{-6} \div 10^{-2}$ Gy are used.

1.INTRODUCTION

In dependence from a concrete range of measured doses of radiations use various physical and chemical methods (ionization, chemical, calorimetric, luminescent, etc.); all of them are based on registration of changes which occur in systems at their irradiation [1-3]

The wide circulation was received by systems with use of firm substances. In these dosimeters as a working material are used a alkali-haloid crystals or glasses. Glass dosimeters have thus in comparison with other solid state dosimeters a lot of advantage. They are simple in manufacturing commercially, have low cost, are steady at storage. At measurement of a dose with the help of glass dosimeters use the following effects; change of painting of a glass, luminescence and etc. These effects increase with growth of a dose of a irradiation and knowing laws of changes on size of effect determine doses. The glass dosimeter has however that lack that does not allow to measure radiation in a range which would cover at once low, average and high doses (~10^{-2} -10^{8} Gy), as well as other types of dosimeters. For achievement of these purposes it is necessary to use a number of dosimeters. Characteristics of some dosimeters with use of glasses of different compositions are below resulted;

№	Type of a dosimeter Effect caused by iradiation	A range of measured doses, Gy	Ref.
1.	Phosphatic Radiofotoluminescence glass with Ag	$0.1 \div 2 \times 10^{2}$	[4]
2.	Phosphatic Colouring glass with Ag	$20 \div 1 \times 10^{4}$	[4]
3.	Si-104 Colouring	$10^{3} \div 10^{7}$ and is higher	[5]

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The purpose of work to give the description a way of dosimetry radiations in a wide range of doses. This purpose has been achieved at use as a working elements of a dosimeter of a glass optical waveguide. The basic scientific preconditions underlying creations of such type of a dosimeter were the following. a) With use of an optical fiber waveguide the range of measured doses extends in area of low doses of radiation due to the big length of a way of probing light in waveguide. b) Selection of composition of a glass. We had been used an waveguide with core of a fibre from SiO2+GeO2 (10 weight % GeO2) and a reflecting environment from SiO2. The additive GeO2 in SiO2 increases a parameter of refraction of a glass, besides, grows $\Delta\Pi$ both a difference between Π_C a core and Π_E an environment of an waveguide. c) Among additives in SiO2 it is possible to use B2O3, P2O5. B2O3 and P2O5 are oxides with low temperature of fusion in comparison with GeO2. During manufacturng optical fiber waveguide oxides with low temperature of fusion burn out more strongly than high-temperature oxides. d) At an irradiation of an optical waveguide growth of the induced centers occurs basically on defects such as E'(Si), E'(Ge), their accumulation in glass goes down to a dose ~10^{7} Gray at various lengths of waves. So at λ=0.63 μm the curve covers area $10^{2} \div 10^{5}$ rad and at λ=1.33 μm area $5 \times 10^{3} \div 10^{9}$ rad[6]. Hence with introduction in an optical waveguide probing light of two or more two lengths of waves it is possible to capture wide area dependences α (db/km) - of factor of absorption on a dose of an irradiation. Based on such principle the author of article had been developed a way of dosimetry

radiations with use of a glass optical fiber waveguide. On the given invention the copyright certificate is received.

Induced absorption (IA) during an irradiation and the first moment after an irradiation represents the sum shortly and long-living IA. Shortly-lived component IA falls down quickly and later 1-3 hours and also day after termination of an irradiation remains constant. Therefore dosimetry of radiation can is made directly during an irradiation of an waveguide and /or after certain time. Value IA practically did not depend on capacity of a dose of an irradiation and was function of only absorbing dose. Signals pass through the irradiated waveguide were compared to a signal pass through not irradiated waveguide – the standard. The basic advantage of the suggested dosimeter in that that it allows to carry out measurement of radiation in a wide range of doses ~ $0.1 \div 10^7$ Gy.

Measurement of a dose the gamma-neutron radiation of an active zone of a nuclear reactor has important significance for safe and stable functioning of installation. The glass optical fiber dosimeter can work in the radiating environment without leading to him of an electric voltage that determines safety its use. Cases for example, emergencies and when intensity of radiation of a source starts to grow sharply are possible and the dose can exceed a limit of sensitivity of a dosimeter; here the system sypervising a condition of a source of radiation is necessary both at small and at the big doses of radiations.

2. REFERENCES

1. Golubev V.P. Dozimetriya i zachita ot ioniziruyuchikh izlucheniy. M.Atomizdat.1971.
2. Pikayev A.k. Dozimetriya v radiazionnoy khimiyi. M. Atomizdat, 1973.
3. Frank M., Shtolz V. Tverdotelnaya dozimetriya. M. Atomizdat.1973.
4. Pikayev A.K. Sovremennaya radiazionnaya khimiya. M.Nauka.1985
5. Burganovskaya G.V.,Vargin V.V.,Leko N.A.,Orlov N.F. Deystviye oblucheniya na neorganicheskiye stekla.M.1968.240s.
6. Guryanov A.N. i dr. Radiazionno-opticheskaya ustoychivost steklyannikh volokonnikh svetovodov s maliymi poteryami. Kvantovaya elektronika.1979.T.6.s.1310-1319.