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Paramagnetic Centres in Irradiated Ultraphosphate Glasses Containing Rare Earth Elements

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PARAMAGNETIC CENTRES IN IRRADIATED ULTRAPHOSPHATE GLASSES CONTAINING RARE EARTH ELEMENTS

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In this study three-component ultraphosphate glasses based on Nd, Gd, Ce penta-phosphates were investigated by the EPR method depending on their synthesis conditions. EPR spectra were recorded using a "Radiopan" (Poland) radiospectrometer with a-c-field frequency 9 GHz and modulation frequency 100 kHz at 77 K. The samples were irradiated at γ - ^{60}Co source. EPR spectra of unirradiated ultraphosphate glasses synthesized in oxidizing conditions exhibit a broad nonstructural line with $\Delta H_{1/2} = 100$ mT which, probably, can be considered as a Gd^{3+} ion cluster. After gamma-irradiation no additive PMC (except hydrogen atoms) arise in these glasses. EPR spectra of nonirradiated glasses synthesized in reductive conditions do not exhibit paramagnetic centres. 4 types of PMC appear in EPR spectra after irradiation: hydrogen atoms doublet with $A_{\text{iso}} = 50$ mT, anisotropic doublet with $A_{\text{I}} = 3.7$ mT, $A_{\text{II}} = 4.6$ mT and $g_{\text{II}} = 2.004$, $g_{\text{I}} = 2.018$ which was earlier considered as a phosphor-acid radical PO_4^{2-} , and two doublets with $A_{\text{I}}^1 = 75$ mT, $A_{\text{II}}^1 = 90$ mT, $g_{\text{I}}^1 = 2.036$, $g_{\text{II}}^1 = 2.033$, and $A_{\text{I}}^2 = 105$ mT, $A_{\text{II}}^2 = 150$ mT and $g_{\text{I}}^2 = 2.082$, $g_{\text{II}}^2 = 2.077$, which can be considered as a hole PMC PO_3^{2-} in different environment. The maximum concentration of these centres does not exceed 10^{15} (absorbed dose 600 kGy/h), and the ratio changes according to glass synthesizing temperature. Thus, ultraphosphate glasses synthesized in oxidizing conditions have a big paramagnetic radiation stability in comparison to analogous glasses synthesized in reductive conditions.