High spatial resolution graded-gap $Al_xGa_{1-x}As$ X-ray imaging detector

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The new type, high spatial resolution graded-gap $Al_xGa_{1-x}As$ imaging detector is constructed with an intent to use it for X-ray microbeam radiation therapy (MRT).

The detector consists of low-doped graded-gap p-$Al_xGa_{1-x}As$ layer, thin high-doped p^+-GaAs layer at the narrow gap side of graded-gap layer and thin p-$Al_xGa_{1-x}As$ layer on the top of the structure. The charge generated by X-ray beam in graded-gap p-$Al_xGa_{1-x}As$ layer is collecting in thin p^+- GaAs layer by graded-gap field. $Al_xGa_{1-x}As$ top layer restricts penetration of collected charge to the surface of the structure. The X-ray luminescence from the thin p^+-GaAs layer through the p-$Al_xGa_{1-x}As$ top layer is detecting by CCD camera. Because of small distance of luminescent p^+-GaAs layer from the surface of the detector and small angle of total internal reflection (16° for GaAs), optical spread of image is negligible (0.5 μm). The factor responsible for edge unsharpness of X-ray image is the diffusion of electrons in graded-gap $Al_xGa_{1-x}As$ layer. Electron diffusion spreading in graded-gap $Al_xGa_{1-x}As$ layer of thickness 20 μm and variation of Al fraction from 0.4 to 0 is estimated as 6 μm.

The experimental measurement of X-ray images shows the spatial resolution better than 25 line/mm.

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