A process for applying blocking contacts on an n-type CdZnTe specimen includes cleaning the CdZnTe specimen; etching the CdZnTe specimen; chemically surface treating the CdZnTe specimen; and depositing blocking metal on at least one of a cathode surface and an anode surface of the CdZnTe specimen.

19 Claims, 1 Drawing Sheet
CLEANING

ETCHING

SURFACE TREATING

DEPOSITING METAL

FIG-1
The invention described herein was made by employees of the United States Government, and may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties thereon or therefore.

BACKGROUND OF THE INVENTION

The invention relates in general to x-ray or gamma ray detectors and in particular to blocking contacts on such detectors.

Cadmium Zinc Telluride (CdZnTe) has gained acceptance as a semiconductor detector material for x-ray and gamma ray applications ranging from astronomy to medical imaging. One challenge remaining for this technology is the production of large volume (greater than 4 cubic centimeters) detectors free of bulk defects (grain and twin boundaries), which are detrimental to detector performance. CdZnTe can be produced by several different Bridgman furnace configurations, for example High Pressure Bridgman (HPB) or Modified Horizontal Bridgman (MHB).

The HPB process produces slightly p-type CdZnTe with a very high bulk resistivity (10^11 Ohm-cm) and, therefore, these detectors have low leakage current noise and good spectral performance. Unfortunately, HPB CdZnTe has a high density of bulk defects that results in a poor yield and high cost for large volume detectors. The MHB growth process produces n-type CdZnTe with a much lower density of bulk defects. However, the material has a relatively low bulk resistivity (5x10^6 Ohm-cm) and, therefore, conventional ohmic contacts yield much higher leakage current noise resulting in a poor spectral resolution. To take advantage of the lower density of bulk defects in MHB CdZnTe, there is a need for contacts having low leakage current noise.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a process of making blocking contacts on n-type CdZnTe. One aspect of the invention is a process for applying blocking contacts on an n-type CdZnTe specimen comprising cleaning the CdZnTe specimen; etching the CdZnTe specimen; chemically surface treating the CdZnTe specimen; and depositing blocking metal on at least one of a cathode surface and an anode surface of the CdZnTe specimen.

The step of chemically surface treating may include etching in sodium hypochlorite. The sodium hypochlorite may be about a 1% sodium hypochlorite solution. The step of etching in sodium hypochlorite may be performed for about 30 seconds.

The step of chemically surface treating may include rinsing in methanol after etching in sodium hypochlorite. The step of rinsing in methanol may be performed for about one minute. The step of chemically surface treating may include the step of drying after rinsing in methanol.

The step of depositing blocking metal on at least one of the cathode surface and the anode surface may include depositing blocking metal to a total thickness of about 800 angstroms.

The step of etching the CdZnTe specimen may include etching in a bromine in methanol solution. The bromine in methanol solution may be about 1% bromine in methanol solution. The step of etching the CdZnTe specimen may include rinsing the CdZnTe solution in a methanol bath after etching in the bromine in methanol solution. The step of rinsing may include rinsing the CdZnTe specimen in first and second methanol baths.

The step of cleaning may include agitating the CdZnTe specimen in acetone. The step of cleaning may include agitating the CdZnTe specimen in methanol after agitating in acetone. The step of cleaning may include agitating the CdZnTe specimen in a de-ionized water after agitating in methanol. The step of cleaning may include examining the CdZnTe specimen under magnification.

Further objects, features and advantages of the invention will become apparent from the following detailed description taken in conjunction with the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing the principal process steps.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention includes a process for applying blocking metal contacts on n-type CdZnTe for the purpose of producing x-ray or gamma ray detectors. The process steps include cleaning with conventional solvents, etching in a bromine solution to remove cutting and polishing damage, surface treating with a chemical, and depositing contacts using a shadow mask in combination with electron beam evaporation of the contact metal.

The inventive blocking contacts reduce CdZnTe detector leakage current by a factor of 10 at bias voltages typically used for n-type CdZnTe detectors with ohmic contacts (approximately 120 Volts per millimeter of thickness). The reduced leakage current noise produces improved spectral resolution. In addition, the reduced leakage current noise allows for the application of higher bias voltages (approximately 200 Volts per millimeter of thickness) thereby promoting full charge collection and further improving spectral resolution.

In one embodiment of the invention, the blocking Platinum (Pt) contacts are applied to n-type CdZnTe. The detectors produced in this embodiment have Pt contacts on both the detector cathode and anode and both contacts are produced using the same process. Pt was selected because of its high work function (5.65 eV) and its demonstrated good adhesion to CdZnTe. The CdZnTe specimens used in the process are supplied with polished surfaces so that further polishing is not needed. The cathode and anode patterns are produced using a shadow mask so that photolithography is not required.

The process uses two fixtures designed for alignment of the shadow masks relative to the specimen. There are separate shadow masks for the planar cathode and the pixellated anode. The specimen is aligned within each fixture. Pre-aligning the specimen in the cathode fixture minimizes the time the CdZnTe is exposed to the open laboratory environ-
What is claimed is:

1. A process for applying blocking contacts on an n-type CdZnTe specimen, comprising:
   cleaning the CdZnTe specimen; etching the CdZnTe specimen; chemically surface treating the CdZnTe specimen; and depositing blocking metal on at least one of a cathode surface and an anode surface of the CdZnTe specimen; wherein the step of chemically surface treating includes etching in sodium hypochlorite.

2. The process of claim 1 wherein the sodium hypochlorite is about a 1% sodium hypochlorite solution.

3. The process of claim 1 wherein the step of etching in sodium hypochlorite is performed for about 30 seconds.

4. The process of claim 1 wherein the step of chemically surface treating includes rinsing in methanol after etching in sodium hypochlorite.

5. The process of claim 1 wherein the step of rinsing in methanol is performed for about one minute.

6. The process of claim 4 wherein the step of chemically surface treating includes the step of drying after rinsing in methanol.

7. The process of claim 1 wherein the step of depositing blocking metal on at least one of the cathode surface and the anode surface includes depositing platinum.

8. The process of claim 1 wherein the step of depositing blocking metal on at least one of the cathode surface and the anode surface includes depositing blocking metal at a rate of about one angstrom per second.

9. The process of claim 1 wherein the step of depositing blocking metal on at least one of the cathode surface and the anode surface includes depositing blocking metal to a total thickness of about 800 angstroms.

10. The process of claim 1 wherein the step of etching the CdZnTe specimen includes etching in a bromine in methanol solution.

11. The process of claim 10 wherein the bromine in methanol solution is about 1% bromine in methanol solution.
12. The process of claim 10 wherein the etching is performed for about four minutes.

13. The process of claim 10 wherein the step of etching the CdZnTe specimen includes rinsing the CdZnTe solution in a methanol bath after etching in the bromine in methanol solution.

14. The process of claim 13 wherein the step of rinsing includes rinsing the CdZnTe specimen in first and second methanol baths.

15. The process of claim 1 wherein the step of cleaning includes agitating the CdZnTe specimen in acetone.

16. The process of claim 15 wherein the step of cleaning includes agitating the CdZnTe specimen in methanol after agitating in acetone.

17. The process of claim 16 wherein the step of cleaning includes agitating the CdZnTe specimen in de-ionized water after agitating in methanol.

18. The process of claim 15 wherein the step of cleaning includes examining the CdZnTe specimen under magnification.

19. The process of claim 1 further comprising the step of providing a polished CdZnTe specimen before the step of cleaning the CdZnTe specimen.