

CLAIMS

1. Double photodiode electromagnetic radiation sensor device (10) comprising:
- 5 - a substrate (25) in a first semiconductor material defining a first face (12, 30) exposed to electromagnetic radiation (EMR) and a second face (32) opposite the first face;
- a first integrated photodiode (PD1) comprising:
- 10 a first doped region (31) included in the substrate (25) so as to extend to the second face (32) and having a first type doping (n);
- a second doped region (33) included into the substrate (25) to extend to the second face (32), separated from the first region (31) by a portion of the substrate (25), having a doping of a second type (p+);
- a second integrated photodiode (PD2) comprising said first doped region
- 15 (31); and:
- a layer in a second semiconductor material (34) placed on the second face (32) in contact with the first doped region (31) and such as to define a third face (35) opposed to the second face (32);
- a doped layer in the second semiconductor material (36) having a
- 20 doping of the second type (p+) and overlapping the third face (35);
- metal contacts (BC, TC) arranged to contact the second doped region (33), at the second face (32), and the doped layer (36).
2. Sensor device (10) according to claim 1, in which said metal contacts (BC, TC) comprise:
- 25 a first metallic layer (37, BC) placed on the second face (32) in contact

with the second doped region (33).

3. Sensor device (10) according to claim 2, further comprising:

a first high doping well (39) having doping of the second type (p+) included in the first doped region (31) and extending to the second face (32);

5 a second high doping well (40) having doping of the second type (p+) included in the layer in the second semiconductor material (34) and such as to contact the doped layer in the second semiconductor material (36) and a first portion of the first high doping well (39) at the second face (32).

4. Sensor device (10) according to claim 3, wherein:

10 said metal contacts (BC, TC) comprise a second metal layer (38, TC) placed over a second portion of the first high doping well (39) at the second face (32).

5. Sensor device (10) according to claim 3, wherein:

15 said metal contacts (BC, TC) comprise a third metal layer (41) covering the doped layer in the second semiconductor material (36) and the second high doping well (40), contacting the first high doping well (39) at the second face (32).

6. Sensor device (10) according to claim 2, wherein:

20 said metal contacts (BC, TC) comprise a fourth metal layer (42) covering the doped layer in the second semiconductor material (36), being spaced from the second face (32).

7. Sensor device (10) according to claim 2, also comprising:

a layer of electrically insulating material (44) placed over the second face (32) and the doped layer in the second semiconductor material (36);

25 and wherein:

said first metal layer (37) extends internally to the layer of insulating material from the second face (32) to a free face (45) of the layer of insulating material forming a first contact pad (46);

5 said metal contacts (BC, TC) comprise a fifth metal layer (43) extending internally to the layer of insulating material from the second face (32) to a free face (45) of the layer of insulating material forming a second contact pad (47).

8. Sensor device (10) according to claim 1, in which the first and/or second semiconductor material is chosen from one of the following types:

- 10 (a) III-V semiconductors and their alloys;
 (b) II-VI semiconductors and their alloys;
 (c) Group IV semiconductors and their alloys.

9. Sensor device (10) according to claim 1, where said first semiconductor material has associated a first band gap E_{g1} and the second semiconductor material has associated a second band gap E_{g2} smaller than said first band gap.
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10. Sensor device according to claim 1, configured to convert the incident electromagnetic radiation (EMR) into photo-detected electric current (I_{ph}) as a function of a respective spectral responsivity dependent on a control voltage (V_B).

20 11. Sensor device (10) according to claims 2 and 10, wherein said metal contacts (BC, TC) define a first (BC) and a second (TC) electrical terminals to which the control electrical voltage (V_B) is applicable and from which the photo-detected electric current (I_{ph}) is readable.

25 12. Sensor device (10) according to claim 1, in which the first and second semiconductor materials are selected so that the sensor device (10) is such that

it operates in the visible, near-infrared to part of the short-wave infrared.

13. Sensor device (10) according to claim 4, also including:

a third high doping well (48) having doping of the first type (p+) included in the first doped region (31) and extending to the second face (32);

5 a further metal layer (FC) placed above said third high doping well (48) at the second face (32) defining a third electrical control terminal of said device.

14. Electromagnetic radiation detection system (100), comprising:

a sensor device (20, 10) manufactured according to at least one of the above claims and configured to convert an incident electromagnetic radiation (EMR) into electrical current as a function of a respective spectral responsivity dependent on an adjusting electrical voltage (V_B);

an electronic control and processing module (50) configured to:

- selectively provide the sensor device (10) with a plurality of adjusting electrical voltage values (V_B) adjusting said spectral responsivity so as to obtain a corresponding plurality of detected electric currents (I_{ph}) associated with the incident electromagnetic radiation;

- process values of such detected electric currents (I_{ph}) basing on the adjusting electrical voltage values (V_B) and said spectral responsivity, obtaining information (SP-ANS; IPST-IM) related to the incident electromagnetic radiation.

15. System (100) according to claim 14, in which the control and processing module (50) includes:

a reading module (2) configured to receive the plurality of detected electrical currents (I_{ph}) and convert it into a plurality of detected electrical voltages (V_{ph});

a conditioning module (3) configured to receive the plurality of detected electrical voltages (Vph) and convert it into corresponding digital detected values (Vphi);

5 an analysis device (4) configured to receive the digital detected values (Vphi) and extrapolate spectrum information (SP-ANS; IPST-IM) of the incident electromagnetic radiation.