deposit an anti-reflection coating on exposed portions of the second subcell and the silicon subcell between grids of the first and second gridded metal layers, respectively. A plurality of spaces are defined between the grids of the first and second gridded metal layers in order to space the second subcell and the silicon subcell apart from one another. An electrical contact may also be formed on the first subcell following removal of the temporary substrate. In one embodiment, an anti-reflection coating may be deposited on exposed portions of the first subcell.

In another embodiment, a method of fabricating an IMM solar cell is provided that includes forming a first subcell comprised of gallium indium phosphide (GaInP) and forming a second subcell of $In_xGa_{1-x}As$ upon the first subcell with $0 \leq x \leq 0.1$. The second subcell has a smaller band gap than the first subcell. In this embodiment, the first gridded metal layer is formed, on the back of the second subcell. Additionally, a silicon subcell having a second gridded metal layer thereon is provided. The method of this embodiment also establishes metal- to-metal bonds between the first and second gridded metal layers of the second subcell and the silicon subcell, respectively. A plurality of spaces are defined between grids of the first and second gridded metal layers in order to space the second subcell and the silicon subcell apart from one another. The silicon subcell may have a larger area than the first and second subcell such that a peripheral portion of the silicon subcell extends beyond the first and second subcells. In one embodiment, the first and second subcells may be formed with respective n/p junctions and the silicon substrate may also be formed with an n/p junction prior to establishment of the metal-to-metal bonds.

The first subcell may be formed, in one embodiment, upon a temporary substrate of gallium arsenide (GaAs) or germanium (Ge). As such, the method may also include the removal of the temporary substrate following the establishment of the metal-to-metal bonds. The method of one embodiment may also deposit an anti-reflection coating on exposed portions of the second subcell between grids of the first metal gridded layer. In regards to providing the silicon substrate, the method may include forming the second gridded metal layer and depositing an anti-reflection coating on exposed portions of the silicon subcell between grids of the second gridded metal layer. In one embodiment, the method also includes forming an electrical contact on the first subcell following establishment of the metal-to-metal bonds. The method of this embodiment may also include depositing an anti-reflection coating on exposed portions of the first subcell.

In a further embodiment, an IMM solar cell is provided that includes first and second subcells. The second subcell has a smaller band gap than the first subcell. The IMM solar cell of this embodiment also includes a silicon subcell supporting the first and second subcells thereupon. The IMM solar cell of this embodiment also includes a metal-to-metal bond between the silicon subcell and the second subcell.

The metal-to-metal bond of one embodiment includes a first gridded metal layer on the second subcell and a second gridded metal layer on the silicon subcell. A plurality of spaces are defined between grids of the first and second gridded metal layers in order to space the second subcell and the silicon subcell apart from one another. The silicon subcell of one embodiment has a larger area than the first and second subcells such that a peripheral portion of the silicon subcell extends beyond the first and second subcells. In one embodiment, the first subcell is provided of GaInP and the second subcell is comprised of $In_xGa_{1-x}As$ with $0 \leq x \leq 0.1$. In this embodiment, each of the first subcell, second subcell and the silicon subcell may have a respective n/p junction. An anti-reflection coating is deposited on exposed portions of the second subcell between the grids of the first gridded metal layer; and an anti-reflection coating is deposited on exposed portions of the silicon subcell between the grids of the second gridded metal layer.

In accordance with embodiments of the present disclosure, an IMM solar cell and associated fabrication methods are provided in order to reduce performance limitations that may otherwise be imposed due to CTE and/or lattice mismatch while continuing to protect against breakage during the fabrication process. However, the features, functions and advantages that have been discussed may be achieved independently and the various embodiments of the present disclosure may be combined in other embodiments, further details of which may be seen with reference to the detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus described embodiments of the present disclosure in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

Figure 1 is a plan view of an IMM solar cell in accordance with one embodiment of the present disclosure;

Figures 2a and 2b are flowcharts illustrating operations performed in accordance with an embodiment of the present disclosure;

Figure 3 is a plan view of the first and second subcells carried by a temporary substrate in accordance with one embodiment of the present disclosure;

Figure 4 is a plan view of a silicon subcell in accordance with one embodiment of the present disclosure; and

Figure 5 is a top view of the silicon subcell of Figure 4.

DETAILED DESCRIPTION

Embodiments of the present disclosure now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments are shown. Indeed, these embodiments may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided