CLAIMS

What is claimed is:

1. A process of fabricating a solar cell, the process comprising:

removing a non-uniform film that covers a backside surface of ~~materials previously formed on~~ a plurality of P-type and N-type diffusion regions to expose ~~a~~ the backside surface of the plurality of P-type and N-type diffusion regions;

after removing the non-uniform film, forming a ~~layer of~~ dielectric stack comprising a plurality of dielectric layers on the backside surface of the plurality of P-type and N-type diffusion regions;

using a laser to form a plurality of contact holes through the ~~layer of~~ dielectric stack, each contact hole in the plurality of contact holes exposing a surface of a corresponding P-type or N-type diffusion region in the plurality of P-type and N-type diffusion regions; and

forming a metal contact in each of the plurality of contact holes to form an electrical connection to an exposed surface of each of the plurality of P-type and N-type diffusion regions.

2. The process of claim 1, wherein the plurality of P-type and N-type diffusion regions ~~is~~ are formed in a solar cell substrate.

3. The process of claim 2, wherein the solar cell substrate comprises a monocrystalline silicon wafer.

4. The process of claim 1, wherein the plurality of P-type and N-type diffusion regions ~~is~~ are formed in another layer formed on a solar cell substrate.

5. The process of claim 4, wherein the another layer comprises polysilicon.

6. The process of claim 1, wherein a metal contact making electrical connection to an ~~P~~N-type diffusion region in the plurality of P-type and N-type diffusion regions passes over ~~an~~ N~~P~~-type diffusion region in the plurality of P-type and N-type diffusion regions.

~~7. A solar cell fabricated using the process of claim 1.~~

~~8~~7. The process of claim 1, ~~A process of fabricating a solar cell, the process comprising:~~

~~providing a solar cell structure having a plurality of P-type and N-type diffusion regions;~~

~~using a laser to form a plurality of contact holes through at least one layer of dielectric that is formed on the plurality of P-type and N-type diffusion regions, each contact hole in the plurality of contact holes exposing a surface of a corresponding P-type or N-type diffusion region in the plurality of P-type and N-type diffusion regions; and~~

~~forming a metal contact in each of the plurality of contact holes to form an electrical connection to each of the plurality of P-type and N-type diffusion regions,~~ wherein a metal contact making electrical connection to a P-type diffusion region in the plurality of P-type and N-type diffusion regions passes over an N-type diffusion region in the plurality of P-type and N-type diffusion regions.

~~9~~8. The process of claim ~~8~~7, wherein contact holes to P-type diffusion regions in the plurality of P-type and N-type diffusion regions are formed with the laser firing in accordance with a first configuration, and contact holes to N-type diffusion regions in the plurality of P-type and N-type diffusion regions are formed with the laser firing in accordance with a second configuration that is different from the first configuration.

~~10~~9. The process of claim ~~9~~8, wherein the first configuration involves the laser firing multiple laser pulses to form a contact hole to a P-type diffusion region.

~~11. The process of claim 8 wherein the plurality of P-type and N-type diffusion regions is formed in a solar cell substrate.~~

~~12. The process of claim 11 wherein the solar cell substrate comprises a monocrystalline silicon wafer.~~

~~13. The process of claim 8 wherein the plurality of P-type and N-type diffusion regions is formed in another layer formed on a solar cell substrate.~~

~~14. The process of claim 13 wherein the other layer comprises polysilicon.~~

~~15. A solar cell fabricated using the process of claim 8.~~

~~16~~10. The process of claim 1, ~~A process of fabricating a solar cell, the process comprising:~~ further comprising forming a deep diffusion region in the plurality of P-type and N-type diffusion regions ~~of a solar cell~~, the deep diffusion having a depth of at least 0.5 μm;

~~using a laser to form a contact hole through a dielectric layer to expose the deep diffusion region; and~~

~~forming a metal contact in the contact hole to electrically connect to the deep diffusion region.~~

~~17. The process of claim 16 wherein the deep diffusion region is P-type and the metal contact passes over an N-type diffusion region.~~

~~18. The process of claim 16 wherein the deep diffusion region is formed in a solar cell substrate that comprises a monocrystalline silicon wafer.~~

~~19. The process of claim 16 wherein the deep diffusion region and another deep diffusion region are formed on a backside of the solar cell, the deep diffusion being a P-~~

~~type diffusion region and the other deep diffusion region being an N-type diffusion region.~~

~~20. A solar cell fabricated using the process of claim 16.~~

~~21~~11. The process of claim 1, ~~A process of fabricating a solar cell, the process~~ further comprising:

forming an anti-reflective coating over ~~an interlayer~~the dielectric stack~~on a backside of a solar cell~~, the anti-reflective coating together with the ~~interlayer~~ dielectric stack being configured to have a particular breakdown voltage~~;~~

~~using a laser to form a contact hole through the dielectric layer and the anti-reflective to expose a diffusion region; and~~

~~forming a metal contact in the contact hole to electrically connect to the diffusion region.~~

~~22~~12. The process of claim ~~21~~ 11, wherein the anti-reflective coating comprises a layer of amorphous silicon and a layer of silicon nitride.

~~23~~13. The process of claim ~~21~~ 11, wherein the particular breakdown voltage is greater than $1x10^7$ V/cm.

~~24~~14. The process of claim ~~21~~ 11, wherein the particular breakdown voltage is configured by decreasing a refractive index of the interlayer dielectric to less than 1.95.

~~25. A solar cell fabricated using the process of claim 21.~~

~~26~~15. The process of claim 1, ~~A process of fabricating a solar cell, the process comprising:~~

wherein ~~forming a dielectric stack on a doped substrate,~~ the dielectric stack ~~having~~ has an optical property configured for a particular type of laser ablation~~;~~

~~using a laser to form a contact hole through the dielectric stack by the particular type of laser ablation; and~~

~~forming a metal contact in the contact hole to electrically connect to the doped region.~~

~~27~~16. The process of claim ~~26~~15, wherein the particular type of laser ablation comprises indirect ablation.

~~28~~17. The process of claim ~~27~~ 16, wherein the dielectric stack has a refractive index less than 1.97 and the laser has a wavelength equal to or longer than 530 nm.

~~29~~18. The process of claim ~~26~~ 15, wherein the dielectric comprises doped silicon dioxide.

~~30~~19. A solar cell fabricated using the process of claim 1~~26~~.