

CLAIMS

What is claimed is:

1. A system (100) for semiconductor etching, comprising:

a semiconductor (108);

5 a laser (104), the laser having an illumination energy below a bandgap energy of the semiconductor; and

a computing device (106) comprising:

a processor (136); and

memory (138) comprising instructions that, when executed by the processor,

10 cause the processor to perform acts comprising:

responsive to receiving an indication of an etch location in the semiconductor, the etch location being a location where etching of the semiconductor is desirably performed, outputting a prediction based upon a physics model, the prediction comprising an illumination location in the semiconductor, wherein the prediction indicates that a hole created at the illumination location is expected to migrate to the etch location, the physics model based upon at least one of :

charge-carrier diffusion in the semiconductor;

an induced electric field in to the semiconductor; or

20 a current flow through the semiconductor; and

controlling output of the laser to cause the laser to illuminate the illumination location in the semiconductor to cause a hole to be created at the illumination location in the semiconductor.

2. The system of claim 1, wherein the etch location is located at a surface of the semiconductor, wherein further the illumination location is located within the semiconductor beneath the surface of the semiconductor.

3. The system of claim 1, wherein the semiconductor comprises a first surface and a second surface, the first surface opposite the second surface, the system further comprising:

a conductor (126) in contact with the second surface of the semiconductor; and

30 a voltage source (120) that applies a voltage between the first surface of the semiconductor and the conductor.

4. The system of claim 3, wherein the conductor comprises a conductive fluid that is transparent to light emitted from the laser.

5. The system of claim 4, wherein the conductive fluid comprises salt water.
6. The system of claim 3, wherein the conductor comprises a conductive film that is transparent to light emitted from the laser.
7. The system of claim 3, wherein the conductor comprises a conductive polymer that is transparent to light emitted from the laser.
8. The system of claim 3, further comprising an etchant solution (110), wherein the first surface of the semiconductor is exposed to the etchant solution during illumination of the semiconductor by the laser, the etchant solution configured to cause etching of the semiconductor at the etch location based upon the hole migrating to the etch location.
9. The system of claim 8, wherein the semiconductor comprises a carbon group element and the etchant comprises hydrofluoric acid.
10. The system of claim 1, wherein the laser is positioned facing a backside surface of the semiconductor and emits light through the backside surface of the semiconductor to the first location in the semiconductor.
11. The system of claim 1, the illumination location being a focal spot of the laser, the focal spot having a first width, the etch location being a spot having a second width smaller than the first width.
12. The system of claim 1, further comprising a plurality of lasers (804, 806, 808), each of the lasers having an illumination energy below a bandgap energy of the semiconductor, the acts further comprising controlling output of the plurality of lasers to illuminate a plurality of locations in the semiconductor to cause a hole to be created at each of the plurality of locations, wherein the holes created at the plurality of illuminated locations migrate to a respective plurality of etch locations in the semiconductor.
13. The system of claim 1, wherein the semiconductor comprises silicon carbide.
14. A method for controlled semiconductor etching, comprising:
applying a voltage between a first surface of a semiconductor and a conductor in contact with a second surface of the semiconductor, the second surface opposite the first surface, the first surface being exposed to an etching solution; and
illuminating the semiconductor at a first location by way of a laser, the laser having an energy below a bandgap energy of the semiconductor, the laser configured to cause a hole to be generated at the first location in the semiconductor, wherein etching of the semiconductor occurs at a second location based upon the hole being generated at the first location, wherein the second

location is located at the first surface of the semiconductor, wherein further the first location is located within the semiconductor and beneath the first surface of the semiconductor.

15. The method of claim 14, wherein the laser illuminates the semiconductor at the first location by emitting light toward the second surface of the semiconductor.

5 16. The method of claim 15, wherein the conductor comprises a conductive fluid that is transparent to light emitted from the laser.

17. The method of claim 14, wherein the laser illuminates the semiconductor at the first location by emitting light toward the first surface of the semiconductor.

18. The method of claim 14, further comprising:

10 providing a desired etch location to a physics model, the physics model configured to output a prediction based upon the desired etch location, the prediction comprising an illumination location in the semiconductor, the prediction indicating that a hole created at the illumination location is expected to migrate to the desired etch location, the physics model further configured to output the prediction based upon at least one of:

15 charge-carrier diffusion in the semiconductor;
the applied voltage between the first surface of the semiconductor and the conductor; or

a current flow through the semiconductor; and

20 wherein the illuminating the semiconductor at the first location is based upon the prediction output by the physics model.

19. A method for selective semiconductor etching, the method comprising:

inducing a voltage between a first surface of a semiconductor and a second surface of the semiconductor, the second surface opposite the first surface, the first surface being exposed to an etching solution;

25 providing a desired etch location to a physics model, the physics model configured to output a prediction based upon the desired etch location, the prediction comprising an illumination location in the semiconductor, the prediction indicating that a hole created at the illumination location is expected to migrate to the desired etch location, the physics model further configured to output the prediction based upon at least one of:

30 charge-carrier diffusion in the semiconductor;
the induced voltage between the first surface of the semiconductor and the second surface of the semiconductor; or
a current flow through the semiconductor; and

illuminating the semiconductor at a first location by way of a laser, the first location being the illumination location, the laser having an energy below a bandgap energy of the semiconductor, the laser configured to cause a hole to be generated at the first location in the semiconductor, wherein etching of the semiconductor occurs at the desired etch location based upon the hole being generated at the first location

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