of thin wafers is ideal for flexible systems, such as smart cards, chip-in-paper and contactless label. Today, the chip thickness is less than 250 μm and will be further reduced. Traditionally, a diamond saw blade is used to dice the wafer. Because of the contact nature of this technology, mechanical damages cannot be reduced without great sacrifice in the dicing speed. All the cutting conditions such as the force exerted, the cutting speed, the cutting depth and the cutting angles have to be well controlled properly to prevent any fracture or crack on the surface of the silicon wafer. Along with the reduced substrate thickness, new materials and structures are introduced to achieve the desired high performance, including inter-layer dielectric with a low dielectric constant, polyimide coating and copper interconnects. These new materials or structures have lower elastic modulus, lower mechanical strength and poorer adhesion between layers than the conventional silicon, which imposes serious difficulty in wafer dicing.

Therefore, it is desirable to provide a wafer cutting method and system that overcomes, or at least alleviates, the above problems.

SUMMARY OF THE INVENTION

Throughout this document, unless otherwise indicated to the contrary, the terms "*comprising*", "*consisting of*", *and the like, are to be construed as non-exhaustive,* or in other words, as meaning "including, but not limited to".

In a first aspect of the present invention, there is provided a method for cutting a semiconductor wafer by generating a crack within the wafer. The method comprises irradiating a pulsed laser beam having a long pulse duration time of 20 μs to 80 μs towards a surface of the wafer; and converging the laser beam to form a focal point so that a focal volume defined by the focal point and a boundary of the laser beam within the wafer is formed; wherein energy encompassed within the focal volume causes the wafer located at a periphery of the focal volume to contract faster than the wafer located within the focal volume,
thereby generating a crack within the wafer extending from said surface of the wafer to another surface of the wafer opposing said surface to cut the wafer.

In a second aspect of the present invention, there is provided a system for cutting a semiconductor wafer by generating a crack within the wafer. The system comprises a laser beam source for irradiating a pulsed laser beam having a long pulse duration time of 20 μs to 80 μs towards a surface of the wafer; and a converging lens to converge the laser beam to form a focal point so that a focal volume defined by the focal point and a boundary of the laser beam within the wafer is formed; wherein energy encompassed within the focal volume causes the wafer located at a periphery of the focal volume to contract faster than the wafer located within the focal volume, thereby generating a crack within the wafer extending from said surface of the wafer to another surface of the wafer opposing said surface to cut the wafer.

BRIEF DESCRIPTION OF THE DRAWINGS

In the figures, which illustrate, by way of example only, embodiments of the present invention,

FIGURE 1 shows a schematic view of the system for laser-cutting a wafer according to a first aspect of the present invention.

FIGURE 2 illustrates the focusing of a laser beam where (I) the focal point is formed below the surface of and within a wafer, (II) the focal point is formed below and outside the wafer, and (III) the focal point is formed above the surface of and outside the wafer according to the present invention.

FIGURE 3 illustrates the phenomenon of the generation of crack within the wafer according to the present invention.

FIGURE 4 illustrates the propagation of a laser-induced crack according to the present invention.

FIGURE 5 shows a schematic view of the system for laser-cutting a wafer according to a second aspect of the present invention.

FIGURE 6 illustrates the focusing of a laser beam via a beam shaper according to the present invention.

FIGURE 7 illustrates the expansion of a laser beam via a beam expander according to the present invention.