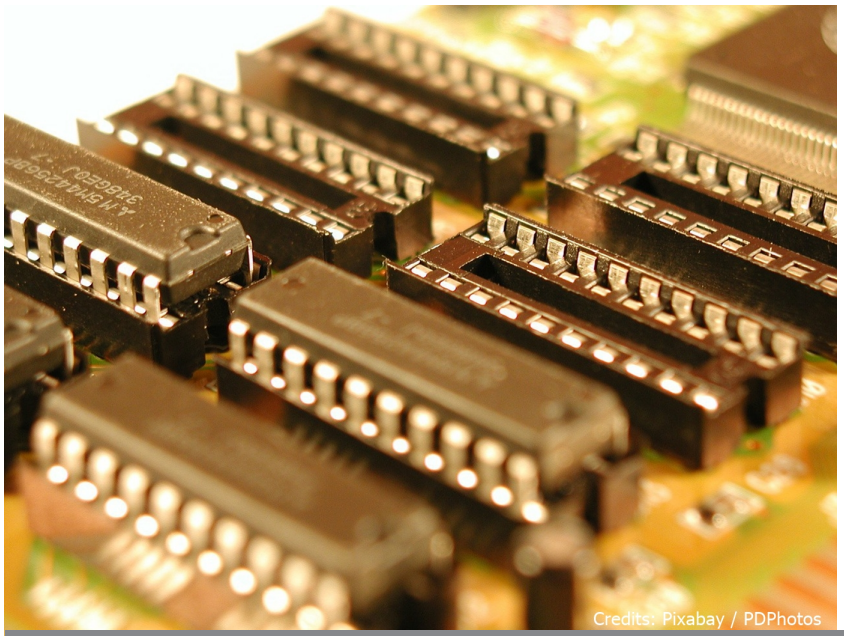
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National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Manufacturing

X-Ray Diffraction Method to Detect Defects in Cubic Semiconductor (100) Wafers

Characterization method for sigma=3 twin defects in cubic semiconductor (100) wafers

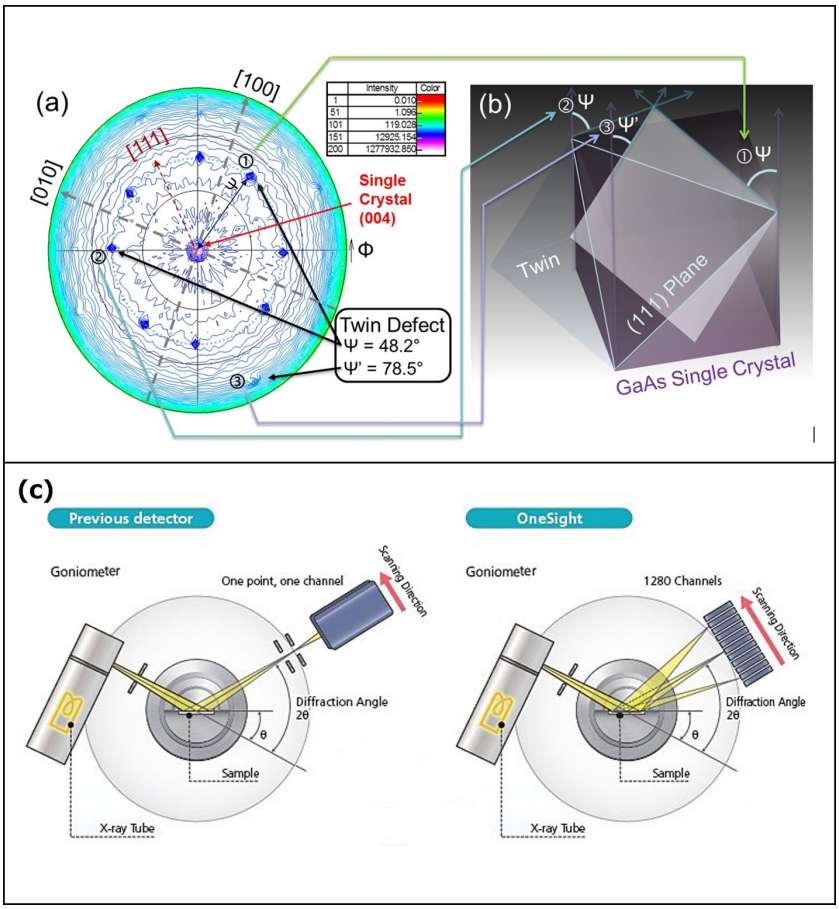
NASA Langley Research Center has developed a method of using x-ray diffraction (XRD) to detect defects in cubic semiconductor (100) wafers. The technology allows non-destructive evaluation of wafer quality in a simple, fast, inexpensive process that can be easily incorporated into an existing fab line. The invention adds value throughout the semiconductor industry but is especially relevant in high end, high speed electronics where wafer quality has a more significant effect on yields.

BENEFITS

- Unlike existing methods of assessing wafer quality, the method is fast and non-destructive.
- The technique can be easily incorporated into an existing fab line.
- The required equipment can be purchased relatively inexpensively.
- Training for instrument operators can be accomplished in two weeks.
- By detecting significant wafer defect problems before circuits are fabricated, yields can be increased considerably and cost issues avoided.
- The method can be used to detect crystal structure defects in any cubic (100) oriented semiconductor crystal, which is more than 90% of commercial wafers and includes silicon, SiGe, GaAs, InP, etc.

THE TECHNOLOGY

This technology is a method of using x-ray diffraction (XRD) to evaluate the concentration of crystal structure defects, and thus the quality, of cubic (100)-oriented semiconductor wafers. Developed to enhance NASA's capabilities in fabricating chips for aeronautics applications, the method supplants existing methods that not only destroy the wafer in question, but can take as long as a day to determine the quality of a single wafer. The approach can be used with any commonly used semiconductor, including silicon, SiGe, GaAs and others, in a cubic (100) orientation, which covers at least 90% of commercial wafers. It can also be used to evaluate the quality of epi layers deposited on wafer substrates, and of ingots before they are sliced into wafers.



(a) Pole-figure of GaAs (004), (b) Angles of twin defects with respect to the original crystal, (c) Typical material characterization method of X-ray diffraction

APPLICATIONS

The technology has several potential applications:

- Semiconductor manufacturing

PUBLICATIONS

Patent No: 9,835,570

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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