Center for Microcontamination Control (CMC)

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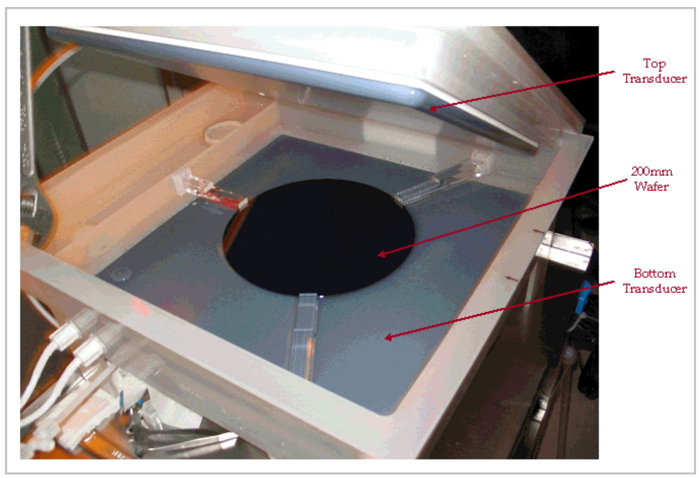
Physical Removal of Nanoscale Particles from surfaces and trenches



Center researchers have developed a substrate independent technique for the removal of nano particles (down to 26 nm) from large areas in a very short time (less than a minute). The technique uses high frequency acoustic streaming in a specially designed tool by the center. The technique has also shown that it is capable of efficiently removing nanoparticles from deep trenches (as deep as 500 microns). This is also the first time that such removal from trenches has been directly demonstrated. The technique has been applied to semiconductor wafers, hard disk media and head, flat panel display, mask, etc. This is the first demonstration of substrate independent removal of nanoparticles. The techniques enable companies to remove nanoscale particles without any effect of sensitive substrates and allows them to use the same process for a variety of substrates. The techniques is based the reduction of the boundary layer thickness from thousands of microns to submicron which allows even low velocity to remove nano particles. This opens the field to many other applications that requires a high shear velocity near the surface. A patent has been filed and a member company (PCT Systems) already made two prototypes. Another member company (Seagate) is ordering an additional prototype to evaluate for their fabrication development based on our results in removing manufacturing defects. For more information, contact Ahmed Busnaina, 617-373-2992; e-mail: a.busnaina@neu.edu

Detection and Scanning of Nanoscale Fluorescent Particles

Above: 28 Nanometer PSL Fluorescent Particles

There is a need to scan and count submicron particles on structured surfaces. No commercial instruments are available for the metrology of submicron and nano particles on structured surfaces such as trenches. Center researchers have developed a simple technique for detecting and counting nanoscale fluorescent particles using an optical microscope. The microscope can count particles as small as 26 nm in areas as large as 100 million square microns. This technique has been used to detect particles on flat substrate and deep trenches and has been instrumental in verifying the surface cleaning technologies on flat and structured substrates. The technique has been applied to semiconductor wafers, hard disk media and head, flat panel display, mask, etc. The technique can give an accurate estimate of the cleaning efficiency of nanoscale particles on any surfaces or microstructures. For more information, contact Ahmed Busnaina, 617-373-2992; e-mail: a.busnaina@neu.edu.

Software for the Design of Silicon Wafers Particle Detector

A software was designed by Prof. Andreas Cangellaris in a project funded by Tencor (Now KLA-Tencor.) This software mapped the signal scattered from a particle located on a bare or oxidized silicon wafer. This software allowed fast plots of the scattered light intensity vs. angle from a particle on a wafer for a given light frequency, angle of illumination. Prior to this development in sparse matrix calculating, super-computers were required to perform these calculations. This knowledge led to the development of the tool. This tool has enhanced signal-to-noise ratio. That is, by locating the detector at its new angle, the ratio of signal to noise was greater. That allowed the detector to locate and identify particles on the rough, backside of a silicon wafer. Tencor engineers used this software to design the optimum location for the illumination source and the scattered light detector in a then-new generation of scanners--the first of which was the Tencor Surfscan (r) 6420. For more information, contact Prof. Andreas Cangellaris, now of the ECE Department, University of Illinois.

Hardware for Observing the Nucleation of Bacteria on the Inside Walls of Ultrapure Water Pipes

A decade ago, the Center for Microcontamination Control sponsored work that lead to Polymerase-Chain-Reaction amplification of DNA in ultrapure-water-born bacteria. Eventually, a process was developed that would measure one bacterium in one liter of water. However, it was then realized that most of the bacteria reside on the walls of the ultrapure water piping in concentrations of 10,000 to 1,000,000-times greater. Semiconductor process contamination results when small areas of the bacterial colonies or biofilms, are released from the surface at infrequent and random intervals. Once this concept was understood, it was realized that the primary issue is detecting the nucleation and growth of bacterial films on the piping materials used in the distribution of ultrapure water. The breakthrough was the development of a new and novel technology that can monitor and detect growth of surface bacterial films. This technology can be made so sensitive that it can detect the protein substance that must deposit before the first layer of bacteria attaches to the piping walls. It can also be made less sensitive for less demanding applications. This device will be of most use in the drug industry, where bacterial monitoring is now coming under more scrutiny and is more serious than in the semiconductor industry. The CMC is currently working with a small business to develop and manufacture this detector. For more information, contact Prof. Jon Sjogren, University of Arizona, jsjogren@ece.arizona.edu.