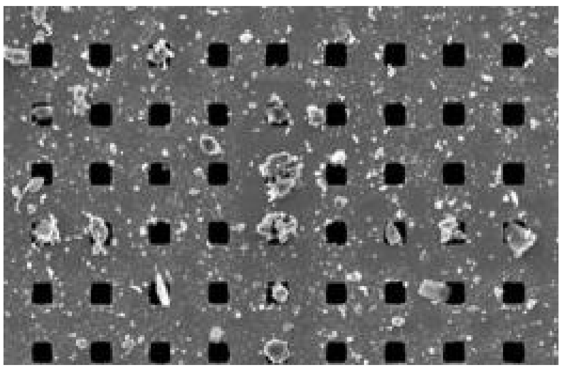
1 room -- 63 different dust particles: Researchers aim to build dust library

October 5 2011, by Pam Frost Gorder



This is a sample of dust particles on the sensor surface. Credit: Images courtesy of Ohio State University.

Researchers recently isolated 63 unique dust particles from their laboratory – and that's just the beginning.

The chemists were testing a new kind of sensor when dust got stuck inside it, and they discovered that they could measure the composition of single dust particles.

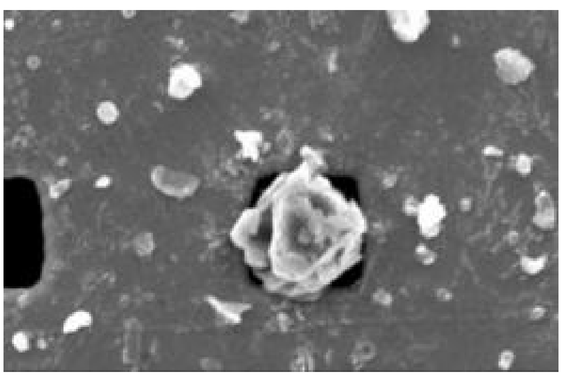
In a recent issue of The *Journal of Physical Chemistry C*, they describe how the discovery could aid the study respiratory diseases caused by airborne particles.

Most dust is natural in origin, explained James Coe, professor of chemistry at Ohio State University. The 63 particles they identified were mainly irregular blobs containing bits of many different ingredients.

The most common ingredient of the dust particles was organic matter, Coe said. "Organic" indicates some kind of plant or animal material, though the researchers can't yet say precisely what kinds of organic matter they found. They are about to do an in-depth analysis to find out.

Quartz was the second-most common ingredient. Both quartz and organic matter were found in more than half of the dust particles the researchers classified. Man-made chemicals from air pollution, fertilizers, and construction materials were also present in small amounts.

"In that way, a single dust particle is like a snapshot of mankind's impact on the environment," Coe said.



This is a close up of a single dust particle on the sensor. Credit: Images courtesy of Ohio State University.

Scientists have had some difficulty getting precise measurements of dust composition, in part because standard techniques involve studying dust in bulk quantities rather than individual particles.

Nowhere is dust composition more important than in public health, where some airborne particulates have been linked to diseases. Coe cited silica dust from mining operations, which causes a lung disease called silicosis.

The patented sensor that Coe's team was testing – a type of metal mesh that transmits infrared light through materials caught in the holes – is ideal for picking up minute details in the composition of single dust grains.

"We can separate particles by size to isolate the ones that are small enough to get into people's lungs, and look at them in detail," he added.

Coe didn't set out to study dust. He and his team invented the metal mesh sensor in 2003, and discovered that they could use it to create surface plasmons – mixtures of conducting electrons and photons. The effect boosts the intensity of light passing through microscopic holes in the mesh, and lets scientists record a detailed infrared light spectrum. Any material stuck in the holes will leave a unique signature on the spectrum, so the sensor can be used to identify the chemicals in microscopic samples.

Early this year, the researchers were testing how light flows through the sensor, and they coated the mesh with a ring of tiny latex spheres to take a baseline measurement. The result should have been a spectrum unique to latex, but instead the spectrum carried the signature of several common minerals due to a single dust particle that had gotten inside the sensor – most likely from the laboratory air.

Coe launched a contest among his students to see who would be the first to take an infrared spectrum of a single dust particle – and an electron microscope image of the same particle. The winner got a free lunch and the chance to name the particle for publication.

Matthew McCormack, then an honors undergraduate student in the lab, won the contest and named the dust particle after his dog, Abby. His study of the particle formed the basis for his honors thesis, and the data has since been used by Coe and other members of the team in publications and presentations.

In subsequent tests, the students were able to isolate and study 63 individual dust particles from the air of their laboratory. The spectra they obtained with the sensor were free of scattering effects and stronger than expected.

The result is a library of common dust components from the lab. Forty of the particles (63 percent) contained organic material. The most common mineral was quartz, which was present in 34 (54 percent) of the particles, followed by carbonates (17 particles, or 27 percent), and gypsum (14 particles, or 22 percent).

Currently, Coe and his team are constructing computer algorithms to better analyze the mineral components and reveal details about the organic components.

A library of common dust components would be useful for many areas of science, he said.

Eventually, researchers in public health could use the sensor as a laboratory tool to analyze dust particles. It could also enable studies in astronomy, geology, environmental science, and atmospheric science.

Provided by The Ohio State University