C_{60}^{2+} ions, focused to a spot size of a few micrometres. The yields of secondary ions obtained using the C_{60} source are typically 50 to 200 times higher than from using gallium LMIGs. The gold-cluster LMIG can produce Au, Au_2^+ and Au_3^+ ions. Secondary-ion yields produced using Au_3^+ ions are typically 10 to 100 times higher than for Ga^+ ions. As the ions from this source can be focused down to smaller spot sizes than with the C_{60} source, it will be the preferred ion source for imaging experiments. On the other hand, the C_{60} source produces a higher yield of molecular fragments from organic and biological samples than the gold source, so it will be preferred for spectroscopic experiments.

Using gallium and indium LMIGs, the spatial resolution for imaging with low-ion-yield molecular fragments is typically limited to a few micrometres: decreasing the pixel size below one micrometre typically causes the number of secondary ions per pixel to drop to essentially zero. But with the increased yield of the gold-cluster LMIG, sub-micrometre spatial resolution could be attainable for molecular SIMS imaging. This will significantly improve the capability of SIMS for imaging the spatial distribution of drugs, proteins and oligonucleotides in a wide range of biomedical devices and sensors.

Although these new cluster-ion sources offer exciting possibilities for SIMS analysis (such as molecular-depth profiling capabilities for organic samples[11], something most SIMS analysts had assumed was impossible), several areas still require additional study. At present it is not understood how cluster-ion beam sputtering can simultaneously achieve higher secondary-ion yields and lower damage rates. Several explanations have been proposed: for instance, perhaps it is because the total ion energy is distributed over all the atoms in the cluster, or because there is overlap in the energy cascades produced when the polyatomic ion strikes the surface. Other questions, such as whether 'increased yield with decreased damage' holds for all types of sample, and whether the concentration of surface species could be quantified, are also unanswered. Further experimental and theoretical research is needed to address these and other issues. ■

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Medicine

Smoke signals for lung disease

Anita B. Roberts

A group of proteins that might confer susceptibility to emphysema has been identified. One of them is transforming growth factor-β, and the discovery highlights the many ways of activating this protein in health and disease.

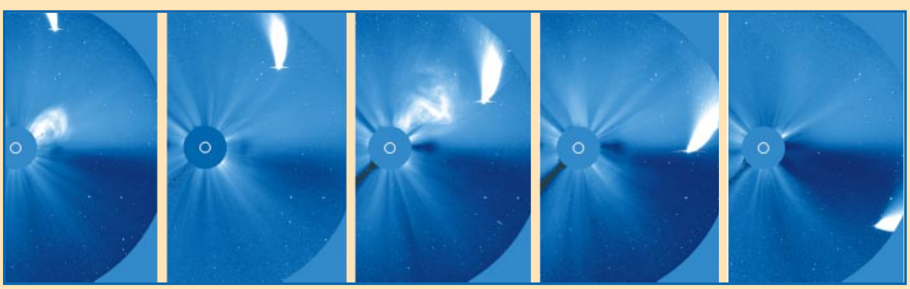
Emphysema is a lung disease that is predicted[1] to become one of the top five causes of death and disability worldwide by 2020. Cigarette smoking is the greatest risk factor for this disease. Despite this correlation, however, only about 15–20% of cigarette smokers develop emphysema. The fact that these susceptible individuals are generally clustered into families hints that there may be certain genes that predispose people to smoking-induced emphysema. On page 169 of this issue, Morris and co-workers[2] describe how they used clues from gene-array technology and manipulation of the mouse genome to implicate an entirely new group of possible susceptibility genes.

Unlike asthma, in which the flow of air through the lungs is temporarily obstructed, emphysema is characterized by a progressive airflow restriction that results from permanent enlargement of the lungs' peripheral air spaces and loss of lung elasticity. In smoking-related emphysema these changes are often attributed to the destruction of lung connective tissue through enzymatic degradation of elastin, the main component of the elastic fibres of lung tissue[1].

Matrix metalloproteinases (MMPs) are zinc-dependent enzymes that can degrade connective tissues, including elastic fibres[1,3]. The gene for the MMP12 protein in particular has been considered a strong candidate for conferring susceptibility to emphysema. MMP12 is produced by macrophages — inflammatory cells that infiltrate smokers' lungs — and destroys not only elastin itself,

Solar System

Close encounter of the cometary kind



Last month, the Solar and Heliospheric Observatory, run jointly by the European Space Agency and NASA, enjoyed a spectacular view, as the comet C/2002 V1 (NEAT) approached the Sun at a distance of around 15 million kilometres — roughly one-tenth of the distance from the Sun to the Earth. The comet is seen here over a 69-hour period.

Hourly images were fed back by the large-angle and spectrometric coronagraph, an instrument studying the Sun's corona, or gas halo. To detect the corona, the coronagraph blots out the disk of the Sun (the star's position is indicated by white circles).

As the comet orbits the Sun, its bright ion tail is deflected by the magnetic field of the solar wind. The striking feature in the centre picture is a huge eruption of gas from the corona. **Alison Wright**