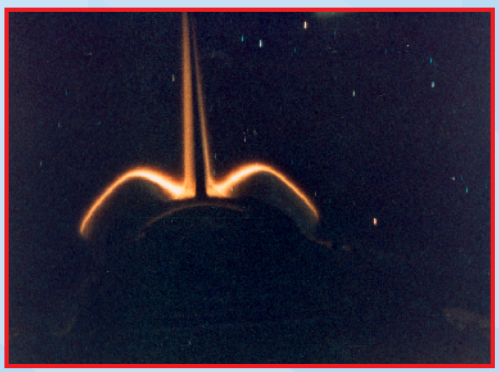
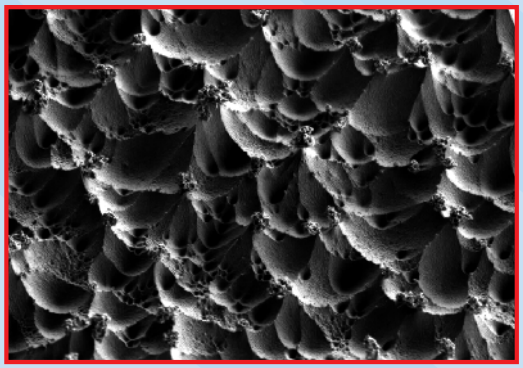
Atomic Oxygen

Space Environment Used for Art Restoration and Surface Texturing

At the NASA Glenn Research Center in Cleveland, Ohio, knowledge of how materials react with atomic oxygen in Earth's orbit has lead to its use in the field of art restoration. Conservators at the Cleveland Museum of Art contacted NASA looking for new technologies that could be used to solve difficult problems in art restoration. One of these areas of difficulty was the removal of soot and char from the surfaces of works of art damaged in a fire. Because soot and char are mostly organic, they can be gently removed by exposure of the damaged surface to atomic oxygen. The photo to the left is of a painting that was damaged in an arson fire. The photo on the right shows the same painting after it was treated with atomic oxygen.

The oxygen that we breathe on the surface of the Earth is two oxygen atoms bonded together. At a distance of 180 to 650 km above the Earth, the atmosphere is less dense and ultraviolet radiation from the Sun can split oxygen molecules into single oxygen atoms. The single oxygen atoms are very chemically reactive and can convert organic compounds like carbon composites or polymers into carbon monoxide, carbon dioxide, and water vapor. The photo on the right, taken from Space Shuttle mission STS–8, shows the tail section of the shuttle. The glowing outline is produced by atomic oxygen reacting with nitrogen on the shuttle's surface and de-exciting, producing a glow. Engineers and scientists at the NASA Glenn Research Center study the reaction of oxygen atoms with surfaces of spacecraft both in space and in environmental simulation vacuum chambers on Earth, to produce more durable spacecraft for operation in the low-Earth orbital environment.





Atomic oxygen also may have applications in the field of medicine. A collaborative program with the Cleveland Clinic Foundation and the NASA Glenn Research Center is investigating the use of atomic oxygen to microscopically etch and texture polymer surfaces to enable better cellular attachment for tissue and cell growth. This will aid the body's healing from procedures such as joint replacements. The photo to the left is a highly magnified (10,000 times) image of a polymer surface microscopically textured using a directed beam of atomic oxygen.

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Cleveland, Ohio

P–0302–1
Sep 01