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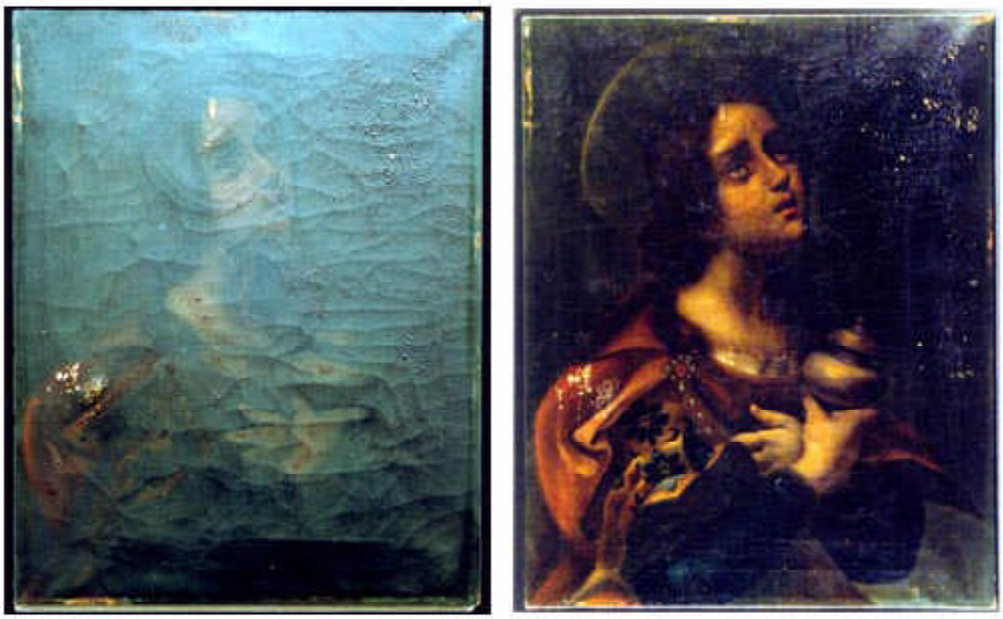
Large-Area Atomic Oxygen Facility Used to Clean Fire-Damaged Artwork

In addition to completely destroying artwork, fires in museums and public buildings can soil a displayed artwork with so much accumulated soot that it can no longer be used for study or be enjoyed by the public. In situations where the surface has not undergone extensive charring or melting, restoration can be attempted. However, soot deposits can be very difficult to remove from some types of painted surfaces, particularly when the paint is fragile or flaking or when the top surface of the paint binder has been damaged. Restoration typically involves the use of organic solvents to clean the surface, but these solvents may cause the paint layers to swell or leach out. Also, immersion of the surface or swabbing during solvent cleaning may move or remove pigment through mechanical contact, especially if the fire damage extends into the paint binder.

A noncontact technique of removing organic deposits from surfaces was developed out of NASA research on the effects of oxygen atoms on various materials. Atomic oxygen is present in the atmosphere surrounding the Earth at the altitudes where satellites typically orbit. It can react chemically with surface coatings or deposits that contain carbon. In the reaction, the carbon is converted to carbon monoxide and some carbon dioxide. Water vapor is also a byproduct of the reaction if the surface contains carbon-hydrogen bonds. To study this reaction, NASA developed Earth-based facilities to produce atomic oxygen for material exposure and testing.

A vacuum facility designed and built by the Electro-Physics Branch of the NASA Glenn Research Center at Lewis Field to provide atomic oxygen over a large area for studying reactions in low Earth orbit has been used to successfully clean several full-size paintings. (This facility can accommodate paintings up to 1.5 by 2.1 m. The atomic oxygen plasma is produced between two large parallel aluminum plates using a radiofrequency power source operating at roughly 400 W. Atomic oxygen is generated uniformly over this area at an operating pressure of 1 to 5 mtorr.



Left: Fire-damaged painting. Right: Restored painting.

The left photo shows a painting that was damaged in an arson fire. The right photo shows the same painting after it was cleaned with atomic oxygen. Because cleaning with atomic oxygen is a dry process, there is less risk of the paint surface leaching out or swelling. In addition, because the atomic oxygen reaction is confined to the surface, risk to the underlying paint or canvas is minimized. With careful use, including pretreatment of an edge or corner to ensure the safeness of the paint for atomic oxygen cleaning, it can be used as an additional conservation tool. The technique appears to have great potential for removing heavy soot and char from the surface of fire-damaged art and may allow previously unrestorable works of art to be restored.

For more information, visit the
http://www.grc.nasa.gov/WWW/epbranch/ephome.htm

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Programs/Projects: Art restoration, art conservation