Innovative application of advanced nanomaterials designing future treatment technology for art conservation

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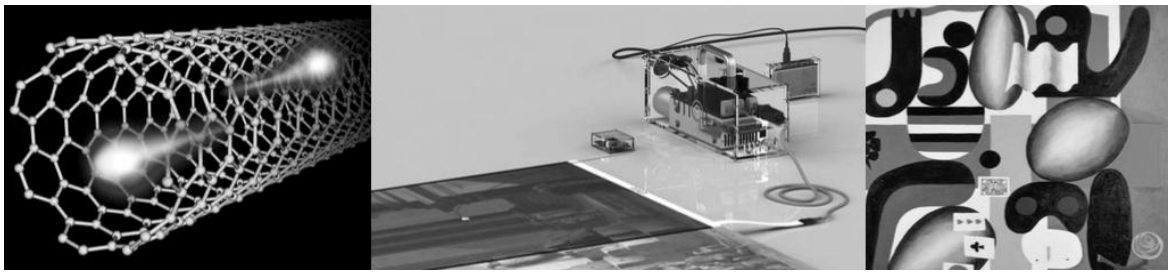
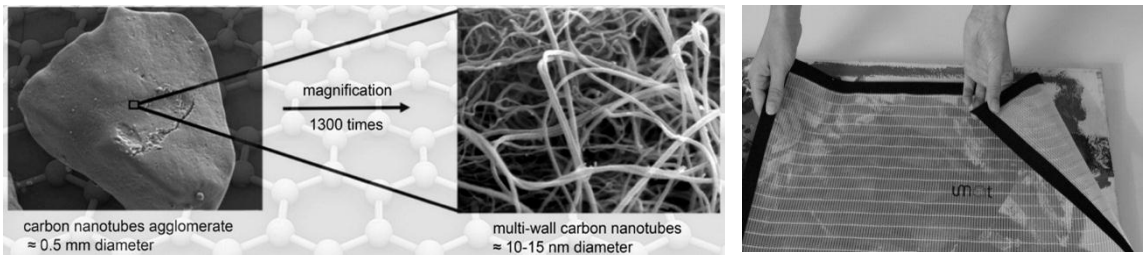
IMAT project under the European Commission under the Seventh Framework Program (FP7) for research (ENV-NMP.2011.2.2-5) coordinated by the University of Florence, Florence, Italy

Keywords: nanotubes, nanotechnology, nanomaterials, conservation, paintings, artworks, warming



Schematic view of a single-walled carbon nanotube (CNT) and IMAT system with a console and transparent warming mat

For those charged with the strategic development of best practices in conservation approaches, it goes without saying that the creation of new conservation materials and sophisticated instrumentation is of fundamental importance, especially in the field of conservation of modern and contemporary art, where the need for non-conventional approaches in treatment choices, cutting-edge scientific research, methodological compromises, ethical dilemmas and constant innovative thinking are paramount. In advanced material science and cutting edge technologies, nano-scale materials are having an ever increasing impact on all spheres of human life and also provide valuable potential for the conservation of modern art. They offer possibilities to invent innovative new conservation materials and technologies with qualities that are unobtainable with the traditional materials.

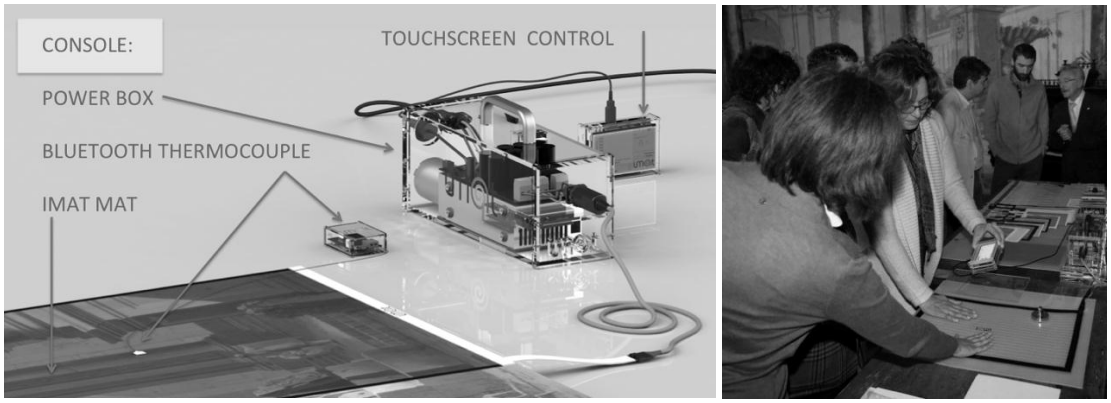


Multi-wall carbon nanotubes (SEM image) and transparent electrically conductive heatable textiles with carbon nanotubes

The paper presents the results of the first successful application of astounding one-atom-thick nanomaterials in art conservation - carbon nanotubes and silver nanoparticles - obtained during the IMAT Research Project under the Seventh Framework Program (FP7) for research (ENV-NMP.2011.2.2-5) coordinated by the University of Florence. The IMAT project explored the application of carbon nanotubes and silver nanoparticles while inventing a series of innovative, mobile, state-of-the-art precision instruments for accurate and selective mild heat transfer. Conservators apply

heat transfer for diverse treatments, but conventional tools cannot provide the required control through accuracy and uniformity of heat transfer, are unable to target locally, lack versatility and mobility and often carry risk or even cause damages. Thermoconductive nanomaterials could change this situation radically.

IMAT heating mat and temperature control console with IMAT wireless sensor and IMAT workshop at Villa La Quete, University of Florence, Florence, Italy, Nov 2014



The mobile IMAT mild heat transfer system, based on carbon-nanotubes and silver nanoparticles, gives superior performance, unsurpassed heating accuracy at low temperature ranges and lower impact. The IMAT project met the need for a flexible, breathable, and transparent contact heater for the use in numerous conservation treatments, including consolidation / flattening of cupped / delaminating paint films, flattening planar distortions of textile or paper support, activating adhesives used for consolidation or attachment of auxiliary support, activating solvent gels or enzymes in cleaning of surfaces, disinfecting textiles and other applications, wherever the safe, selective and accurate heating has to be applied.

The paper explores the working principles of mobile IMAT warming system based on innovative electrically conductive *smart* textiles with electrically and thermally conductive nanomaterials, which employs an ultra low voltage electricity to provide a combination of uniform and accurate radiant and conductive warming. The new technology is illustrated with selected treatments by conservators in Italy, the Netherlands and USA where the new CNT heating mats were successfully experimented and used in actual treatments. The paper discusses how this new application of nanotechnology could increase the safety and efficiency of diverse conservation treatments filling a critical gap in the conservator's toolbox for an instrument that provides accuracy, selectivity and portability when the application of heat is required, emphasizing the need for continuous innovation and integration of contemporary science and cutting edge treatment technologies, fundamental for the advancement of art conservation.