Nanocomposites effect on laser ablation rate of treated marble samples

Laura BERTANI, ENEA

The laser ablation of polymeric materials has attracted a growing attention in the last decades, mainly due to their chemical properties and to the versatility of the technique. In addition, recently, nanomaterials have been used to considerably enhance mechanical strength, hydrophobicity and photo resistance of polymers for a great variety of applications and in particular for preservation and consolidation of architectural and cultural heritage surfaces.

A systematic study on the interaction between laser radiations in the IR region (in particular at 1064 nm and 2100 nm) and polymeric materials, pure and doped with nanoparticles, is here presented. The polymer selected for tests is a commercial copolymer of methyl and ethyl-methacrylate, namely PEMA, commonly used as protective coating in preservation of artistic objects. SiO_2 and TiO_2 nanoparticles were selected for their more and more frequent use in restoration and conservation of artworks due to marked hydrophobic and self-cleaning properties. Films of pure polymer and nanocomposites, prepared dispersing SiO_2 and TiO_2 nanoparticles in the selected polymer, have been applied on specimens of grey Carrara marbles, a substrate commonly used for outdoor cultural heritage.

Ablation tests with different experimental parameters, such as laser pulse duration and energy, have been performed and their effects have been evaluated from both an optical and a chemical point of view by means of microscopy and spectroscopic techniques. Profilometry helped in defining the amount of ablated material and crater shapes.

The obtained results revealed a significant influence of nanoparticle presence on the ablation rate of the embedding polymeric matrix and even of the substrate.