

Supplementary Material

Electrokinetic Characterization of Natural Stones Coated with Nanocomposites for the Protection of Cultural Heritage

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Scanning electron microscopy images were acquired in back-scattered electrons (BSE) mode on a Zeiss EVO 50 EP environmental scanning electron microscope (ESEM).

In the case of Apuan marble (Figure S1), both treatments are clearly visible, homogeneously covering and modifying the crystalline compact surface morphology of the stone; the WNC layer (Figure S1B) is affected by a diffused network of shrinkage cracks.

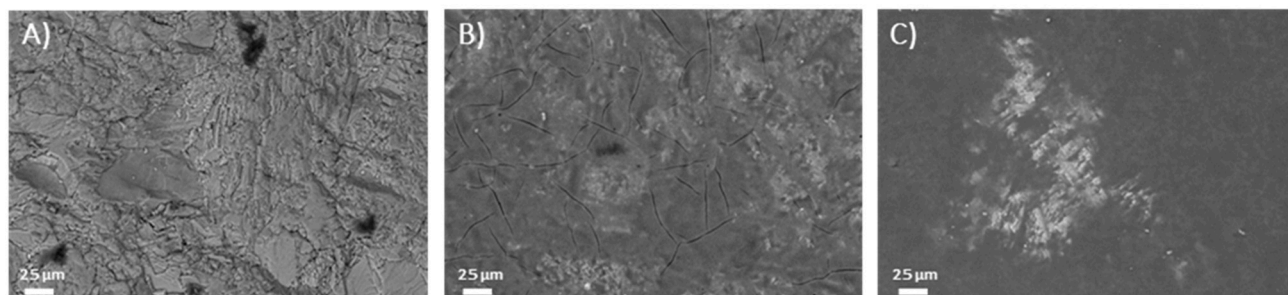


Figure S1. Environmental scanning electron microscope (ESEM) -BSE images of Apuan marble: (A) untreated; (B) treated with WNC; (C) treated with ANC. Magnification: 1000×.

As concerns Balegem (Figure S2), the surface morphology is given by the mineralogical composition of the stone, where the silicate clasts are included in the micritic calcite cement. It is not possible to detect the coatings clearly on the surface of the lithotype at any magnification; in some sporadic more compact areas, it can be perceived that the alcohol-based product (ANC) accumulates in small micrometric aggregates (Figure S2C, indicated by the arrow).

The surface morphology of Obernkirchen (Figure S3A) is derived from silicate clasts immersed in minute silicate crystals, with deep visible surface pore apertures. These characteristics are maintained after the treatment with WNC, for which no morphological change can be evidenced (Figure S3B); on the contrary, in the case of ANC, the treatment can be clearly perceived inside the crystal boundaries and partially filling the large apertures and surface holes (Figure S3C). Actually, the ratio in average dry matter absorbed by the stone between WNC and ANC is high, nearly 1/3.

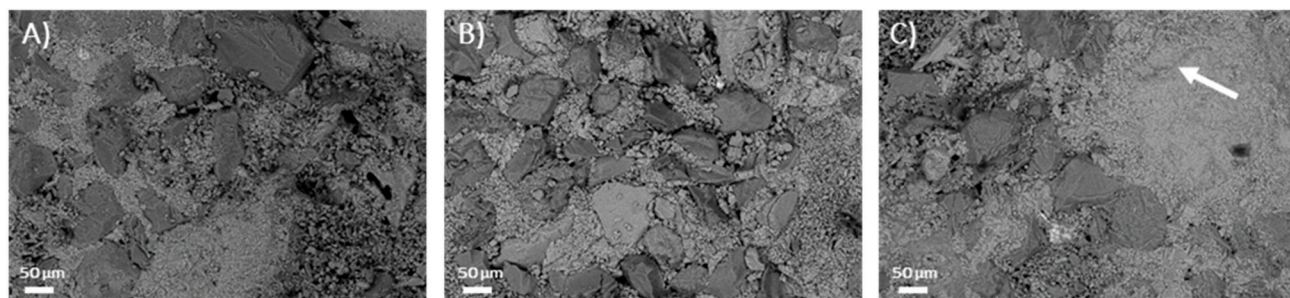


Figure S2. ESEM-BSE images of Balegem stone: (A) untreated; (B) treated with WNC; (C) treated with ANC. Magnification: 500 \times .

The apparently higher surface accumulation of the ANC product in the two most highly porous stones may be associated with the higher product pickup (dry matter absorbed per unit area; Table 3) and the lower penetration effectiveness of the alcohol-based formulation.

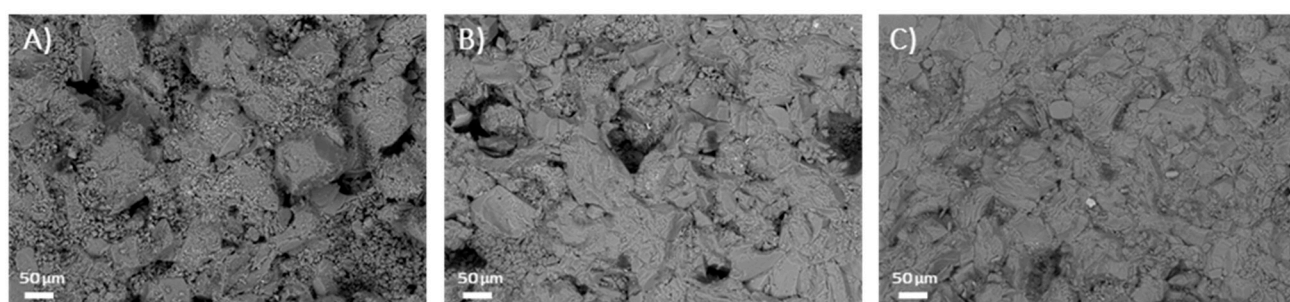


Figure S3. ESEM-BSE images of Obernkirchen stone: (A) untreated; (B) treated with WNC; (C) treated with ANC. Magnification: 500 \times .