

# Historic building materials from Alhambra: Nanoparticles and global climate change effects

Marcos L.S. Oliveira, Carolina Dario, Bernardo F. Tutikian, Hinoel Z.Ehrenbring, Caliane C.O. Almeida, Luis F.O. Silva

## Abstract

Advanced microscopy analyses are capable of revealing particles that are existent in the Alhambra, Spain, a UNESCO World Heritage Site, at minimal levels owing to the detailed directing on ultra-fine (UFPs) and nano-particles (NPs) of importance. This applied technique is one of the most used to natural samples. Between the diverse archaeological places in the planet, Alhambra is one of the most important representations of Hispano-Islamic architecture and art significant Muslim virtuosity in its conclusive European periods, thus helping to offer scientific material about the still little studied Islamic art. In this study, advanced microscopy analyses—has been applied to understand minor portions of UFPs and NPs of pollutants in external walls exposed to weathering. Several materials identified by X-Ray Diffraction can be detected using HR-TEM/FE-SEM and vice versa. The occurrence of anglesite, gypsum, hematite containing PHEs, and several organic compounds associated with modifications due to moisture and pollution was also demonstrated.

Keywords:

Air pollution, Geochemistry, Construction performance impacts, Cultural heritage building degradations.