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ABSTRACT:

Advancing Materials for preserving Built Heritage: A Journey from Nanotechnology to Practical Application

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In the last years, climate change is producing a significant increase of pollution in our cities, which is accelerating built heritage decay, even in materials considered traditionally durable as concrete. In this scenario, traditional buildings preservation strategies require a deep adaptation to the new reality by using cutting-edge technologies. Our research group have employed nanotechnology to develop advanced materials specially designed to preserve built heritage, with a special focus on historic concrete. Specifically, we develop alkoxysilane-based sols with the ability to penetrate into pore structure of decayed concrete, producing calcium silicate hydrate (C-S-H) gel, the main product of cement paste and responsible for the strength of cement-based materials [1]. We have also employed this strategy in carbonated stones, which show a poor interaction with alkoxysilanes. The performance and durability of advanced materials developed in our lab have been validated in significant historic buildings across Europe.

On the other hand, our research has also focused to develop superhydrophobic treatments preserving buildings against water. Recently, we have also employed a new paradigm, changing completely the rules followed up to now for protecting buildings. This new strategy is based on the production of superhydrophilic building surfaces with hydrophobic performance inside their pore structure, instead of superhydrophobic ones [2]. This novel approach is especially interesting in urban and industrial areas, where the effect of non-polar pollutants (soot particles or oily aerosols) is becoming significant, since superhydrophobic surfaces are not effective to remove this pollutants. Additionally, these superhydrophilic surfaces can preserve buildings against biofouling, promoted by global warming, by reducing the effective cell-solid contact area.

[1] R. Zarzuela,.., M.J. Mosquera. Cem. Concr. Res. 130 106008 (2020).
[2] L.A.M. Carrascosa,, M.J. Mosquera, ACS Appl. Mater. Interfaces. 12 19974 (2020).