

## **Abstract**

Fiber-based materials have enlarged greatly their range of applications due to their unique properties and features. The possibility to tailor the properties of fibers and composites in a multiscale approach is one of the most promising scientific achievements accomplished in the last few decades. This allows fiber-based materials to combine performance, adaptability and sustainability meeting the requirements of very exigent applications like building and architecture, aerospace, defense, medicine or transportation systems.

The development of sustainable and multifunctional cementitious composites has gained increasing attention as a strategy to enhance structural performance while reducing environmental impact. Recent research carried out by the author´s team has demonstrated that the incorporation of nanomaterials, such as carbon nanotubes and graphene nanoplatelets, into cement matrices leads to significant improvements in mechanical strength, fracture energy, and toughness, in addition to enabling multifunctional behaviors such as piezoresistive self-sensing for structural health monitoring and heating dissipation ability. In parallel, the use of natural fibers and nanocellulose as eco-friendly reinforcements has shown a strong potential to improve ductility, durability, and microstructural refinement, while supporting the transition toward greener construction practices. The integration of nanotechnology and bio-based materials in cementitious systems in a multiscale approach thus provides a promising pathway for the design of high-performance, intelligent, and sustainable construction materials.

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