Advances in innovative and sustainable materials

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The concepts of innovation and sustainability are at the forefront of European research development and found the maximum expression in their application to materials. Here, the use of specific characterization tools will pave the way for the rationalization of the structure-properties relationships, thus also enabling an *a-priori* design of the next generation of materials. My interest has been firstly devoted to inorganic (*e.g.* metal oxide) nanostructured materials, investigating their structural, electronic and morphological features toward a smart implementation in energy-related applications. These efforts have been then extended to hybrid compounds (*e.g.* metal-organic frameworks, MOFs and MOF-inspired materials) exploited both in the selective uptake of gases and for catalytic purposes.
Considering the quest for sustainability, I focused my attention on the development of green and energy-saving synthetic protocols, and this brought me to the Deep Eutectic Solvents (DES) field. The chemistry of DES is ruled by the hydrogen bond network described by the interaction of an inorganic salt (playing the role of hydrogen bond acceptor) and an organic compound, which is a hydrogen bond donor. These unconventional molecular systems have been named *the solvents of the 21st century* due to their high biocompatibility and green features, coupling tuneable properties and high sustainability. DES are ubiquitously exploited in the different technological fields ranging from metal processing to CO_2 capture from organic synthesis to energy storage. Once more, my scientific efforts are focused on the rationalization of structure-properties relationships (largely unknown in the DES field) toward a thoughtful of DES properties based on a properties-driven design.
This contribution will give an overview of this topic, with a specific focus on the ongoing research themes.