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ABSTRACT:

Novel absorber materials for solar thermal applications: Nanofluids and High Temperature Ceramics

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The solar absorber material is a key element for the efficiency of solar thermal technologies. In this presentation, I will outline the potential of nanomaterials for different solar thermal technologies. In parabolic trough collectors (PTC), nanofluids (i.e. suspensions of nanomaterials in liquids), with their double function of direct solar absorber and thermal transfer medium[1], allow a new approach exploiting the volumetric harvesting of solar energy, in contrast to conventional surface-based absorbers.
Considering solar thermal architectures operating at higher temperatures (e.g. solar towers), refractory and ultra-refractory ceramics can increase beyond the state of the art the operating temperatures, and thus the efficiency of the systems. I will show how multi-scale optimization is the key to design a new class of ceramic absorbers for both performance and durability[2]. At the micro- and nano-scale it is possible to tailor their optical properties, optimizing the interaction with both the dissimilar spectra of solar and thermal radiation[3]. Moreover, some of these ceramics such as lanthanum hexaboride (LaB6) can potentially simultaneously play the role of high-performance thermionic cathode and solar receiver for concentrating systems, being its properties (optical, thermal, electric, thermo-electronic) competitive for a highly efficient solar-to-electrical conversion[4].

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[2] L. Zoli, S. Failla, E. Sani, D. Sciti, Composites Part B: Eng., 242, 110081 (2022).
[3] E. Sani, D. Sciti, S. Failla, A. Bellucci, M. Mastellone, S. Orlando, D.M. Trucchi, submitted (2024)
[4] A. Bellucci, M. Mastellone, M. Girolami, V. Serpente, E. Sani, D. Sciti, D.M. Trucchi, Ceramics Int. 47, 20736 (2021)