SEMINARIO

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Materials and Optoelectronic Devices for Harsh Environments

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Solid-state high-temperature converters and ionizing radiation detectors are under development at the DiaTHEMA Lab of ISM-CNR. These different applications share the peculiarity that resulting devices have to operate in harsh environments, in presence of high temperature, high energy radiation, etc.

High-temperature solar cells and thermal energy converters are feasible by exploiting temperature-driven mechanisms, such as thermionic-thermoelectric generation [1], thermionic-photovoltaic conversion [2, 3], and photon-enhanced thermionic emission (PETE) concept [4], which represent novel and promisingly efficient (>50%) mechanisms for the exploitation of concentrated sunlight. Ultrashort laser pulses can tailor the optical properties of concentrated sunlight absorbers by maximizing solar absorption and selectivity thanks to surface periodic nanostructures [5]. Solar thermionic energy converters with nanotextured surface have already been demonstrated to enhance the selective absorption in prototypes based on nanodiamond emitters. More advanced PETE converters rely on the concept that engineered semiconductor photocathodes can provide an efficient electron emission, obtained by a synergistic combination of photogeneration and thermionic emission. Surface nanotexturing induced by ultrashort laser treatments can also tailor the electronic properties of semiconductors, so that PETE cathodes can be drastically enhanced in terms of photosensitivity even to sub-bandgap radiation.

Sensitive and rad-hard ionizing radiation detectors are fundamental for a wide range of applications, such as medical screening, aerospace monitoring, and nuclear energy. Starting from the DiaTHEMA's scientific core consisting of diamond detectors' development, perovskite-based photodetectors [6] will be reported as possible alternative when large-area monitoring is needed.

References:

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