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Low power up-conversion nano-materials for solar applications and bio-theranostics

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Luminescence-based techniques continue to attract considerable attention due to their broad range of applications and to their potential in the fields of optical devices and biomedicine. Many materials exhibit Stokes shift luminescence, thus they emit lower-energy photons under excitation with higher-energy photons. As opposite, photon up-conversion (UC) is a process which leads to the emission of light at energy higher than the absorbed (anti-Stokes shift). UC materials are largely studied for their potential application in solar devices (SD) technology, to recover the low energy tail of the solar emission, and as optical probes for biological imaging, due to the high contrast given by the UC anti-Stokes emission. Therefore, low power triplet-triplet annihilation assisted up-conversion (TTA-UC) in organic systems has been proposed in 2006 as a straightforward strategy to manage photon's energy. Thanks to its high efficiency with non–coherent excitation, TTA-UC is currently the strongest candidate for application in SD technology with an estimated maximum improvement of the solar cell performance up to 50% for standard photovoltaic devices and 100% for photo-catalytic water splitting cells. On the other hand, TTA-UC based nanoparticles are preferable to inorganic up-converters for the better bio-compatibly of organics and the significantly higher efficiency at low power, reducing the potential damage to the biological environment. Consequently, high-energy blue photons are easy available for drug/contrast agents and chemical reactions activation. A careful analysis of the photophysics involved in the process will be presented, enlightening the guidelines for the development of appealing nanomaterials suitable to be employed as efficient photon up-converters in real applications.

Biography

Angelo Monguzzi received the PhD degree in Materials Science in 2008 at the University of Milano-Bicocca. He started his research working on hybrid light emitters for telecom, in the framework of several national and international project and networks. The topic of his current research is the triplet-triplet annihilation assisted up-conversion of non-coherent photons in multicomponent organic systems. In 2009, he has been awarded by the Italian Society of Physics. In 2014, he has been Fellow of the Japan Society of the Promotion of Science and he has been awarded with the Edison S.p.A "Physics 2014" Scholarship for the collaboration with the ETH-Zurich in Switzerland.

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