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New materials for radiation sources in the mid-infrared region

The mid-infrared region (MID-IR) is usually considered spanning from 3 to 8 μm wavelength. This is an extremely useful region for many applications because roto-vibrational transitions of molecules lie in this region. In fact, possible applications comprise material analysis, quality control, dynamic measurements, environmental and medical monitoring applications, forensic testing, analysis of art objects, etc. Historically, laser sources in this region were bulky and did not permit the development of wide-spread applications. The situation dramatically changed in the last decades with the advent of compact coherent sources like quantum cascade lasers, which, unfortunately, possess intrinsic limitations as for output peak power and beam quality. Moreover, most quantum cascade lasers must be operated at cryogenic temperature, although room temperature operation is possible with strong performance limitations. A completely different approach for MID-IR quantum light generation is the use of doped insulating crystals as active media. Transition metals like Cr^{2+} and Fe^{+2} have already been used as dopant agents for broadly tunable pulsed emission, but the use of rare earths can widen the emission wavelength regions available and permit continuous wave (CW) emission with excellent beam quality. Another, more exotic, possibility is the achievement of polariton lasing in semiconductor heterostructures. A brief review of the state of the art and recent developments in this field will be given.

Biography

Alessandra Toncelli has completed her PhD in Physics in 1998 from the University of Pisa. She is Associate Professor at the same University. Her main scientific interests concern the optical spectroscopy of materials in various wavelength regions from the visible to the infrared and THz region. The aim is either to study the material itself (semiconductors, 2D materials, crystals, nanoparticles, polymers, etc.) or the light-matter interaction in new regimes (strong coupling). She has published more than 170 papers in international peer-reviewed journals and currently holds an h index of 41 in Scopus and 42 in ISI Web of Science databases.

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