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Frequency doubling in AlGaAs micro disks at 1.55 μm

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Frequency conversion can be very efficient in whispering gallery mode semiconductor micro resonators, thanks to high optical confinement and modal overlap. The crystallographic symmetry of AlGaAs, along with the circular geometry, provides effective quasi-phase matching without the burden of domain inversion. In this framework, some experimental studies have been recently reported on Second Harmonic Generation (SHG) in GaAs WGM microdisks. However, GaAs does not allow working with a Fundamental Frequency (FF) mode in the third fiber window of the telecom range, since the SH photon energy exceeds the energy gap and two-photon absorption losses are high up to 1800 nm. Here we report on the demonstration of CW SHG in Al_{0.4}Ga_{0.6}As suspended micro disks on GaAs pedestal, with FF wavelength around 1.55 μm and an efficiency $\eta = 0.7 \times 10^{-3} \text{ W}^{-1}$ comparable to state-of-the-art monolithic telecom devices. This result was obtained via the evanescent coupling between the disk and a tapered fiber, with 3.5 mW input power injected in the fiber. Then we discuss the down-conversion that can occur in the same micro disk, with inverted roles for the SH (which becomes the input pump) and FF (which corresponds to the output signal and idler). In this case, with 3 ps pulses and a repetition rate of 300 kHz, a peak power of about 10 kW at 775 nm can provide signal and idler peak power of about 5 μW at degeneracy. Finally, we illustrate the fabrication of the monolithic counterpart of such submicron-system, with a suspended AlGaAs nano wire in lieu of the fiber.

Biography

Giuseppe Leo received a Master in EE at "La Sapienza" University of Rome (Italy) and a PhD in Physics at the University of Orsay (France). From 1992 to 2004 he has been with the Rome-III University as an Assistant Professor and then as an Associate Professor. Since 2004 he has been full Professor at the Paris Diderot University (France) and Head of the Nonlinear Devices group of MPQ Laboratory since 2006. His research domains include nonlinear optics and quantum optoelectronics, with a focus on AlGaAs platform. He has coordinated several research programs and published 80 articles, 9 book chapters and >150 conference papers. He has also edited 1 book and registered 3 patents. He is the Director of the Denis Diderot School of Engineering.

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