Coupling of semiconductor carbon nanotubes emission with silicon photonic microring resonators

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Resume : Hybrid structures are needed to fully exploit the great advantages of Si photonics and different approaches have been addressed where Si devices are bonded to different materials and nanostructures. Here we experimentally study the use of semiconductor carbon nanotubes for emission in the 1300 nm wavelength range to functionalize Si photonic structures in view of optoelectronic applications. The Si microrings are fully characterized by near field forward resonant scattering with 100 nm resolution. We show that both TE and TM modes can be addressed on the top of the microrings in a vectorial imaging of the in-plane polarization components. We coupled the Si microresonators with selected carbon nanotubes for high photoluminescence emission. Coupling of the nanotubes with the evanescent tails in air of the electric field localized in the photonic modes of the microresonators is demonstrated by sharp resonances overimposed to the nanotube emission bands. By mapping the Si and the nanotubes emission we demonstrate that strong enhancement of the nanotubes photoluminescence can be achieved both in the photonic modes of microdisks and slot microrings, whenever the spatial overlap between nanoemitters and photonic modes is fulfilled.