CARBON NANOTUBES PHOTONICS: PURIFICATION EFFECTS ON NANOTUBE OPTICAL AND ELECTRICAL PROPERTIES

N. Izard[1], A. Noury[1], E. Gaufrès[2], X. Le Roux[1] and L. Vivien[1]

1-Institut d'Electronique Fondamentale, CNRS-UMR 8622, Univ. Paris Sud, Orsay, France
2-Martel Group, Univ. Montréal, Montréal, Canada
nicolas.izard@u-psud.fr

The use of optics in microelectronic circuits to overcome the limitation of metallic interconnects is more and more considered as a viable solution. Numerous photonic building blocks, compatible with CMOS technology, have been developed. However, integration of all these building blocks on the same chip is a bottleneck, due to the various materials used (Ge, Si, III-V). This drawback could be significantly overcome by considering carbon nanotubes, which have the ability to emit, modulate and detect light in the wavelength range of silicon transparency. That makes them a promising candidate and in consequence an alternative material for active device in silicon photonics technology.

Few years ago, we have developed an efficient method to extract semiconducting nanotube (s-SWNT), using a polyfluorene agent in toluene followed by ultracentrifugation steps [1]. We demonstrated that this method allows obtaining metallic-free s-SWNT samples, as confirmed by photoluminescence, absorption and Raman spectroscopy, and the realisation of high Ion/Ioff FET devices.

This achievements leads to the first experimental demonstration of a strong optical gain of 160 cm^{-1} at a wavelength of 1.3 µm in (8,7) s-SWNT at room temperature [2]. A special emphasis will be put on the s-SWNT extraction, as optical gain could not be achieved in a raw or lowly extracted sample.

Carbon nanotube properties were then relied on the existing silicon photonic platform, and we envision the use of carbon nanotubes as active optoelectronic devices in silicon. A complete study of the coupling between carbon nanotubes and silicon waveguides was performed [3]. In particular, temperature independent emission up to 100°C from carbon nanotubes in silicon was demonstrated, which opens bright perspectives for future high performance integrated circuits.

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