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Light induced tunnel effect in CNT-Si photodiode

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Negative differential resistance (NDR), the current is a decreasing function of the voltage, has been observed in the current-voltage curves of several types of structures. We measured tunnelling current and NDR by illuminating large area heterojunction obtained by growing Multi Wall Carbon Nanotubes on the surface of n-doped Silicon substrate. In the absence of light, the current flow is null until a junction threshold of 2.4 V, beyond which the dark current flows at room temperature with a very low intensity of few nanoampere. When illuminated, a significant current of tens or hundreds nanoampere is observed, depending from light wavelength and intensity, at a drain voltage of about 1.5 V. At higher voltage the current intensity decreases according a negative resistance of the order of tens Mohm.

In this talk we report details of tunnelling photodiode realized and negative resistance characteristics.

Collaboration

PARIDE Experiment Collaboration

Summary

In this paper we report the results of a negative differential resistance behavior generated by the incident radiation as a function of wavelength and power intensity for a new photosensitive device consisting of MWCNTs grown at 700 °C on a silicon substrate realized by FBK. The junction presents rectifying properties with a 2.4 V threshold to the flow of reverse current, a strong photosensitivity to light radiation with a wavelength between 378 and 980 nm, a very broad plateau extended over a large range of drain voltage and good photoresponsivity linearity versus light intensity.

The most surprising effect is the observation of a remarkable photoinduced significant resonant tunneling-like current completely absent in dark conditions and which is absent in the substrate without CNTs. Therefore, resonant tunnel-like current is generated only under light radiation and it is function of the wavelength as well as of the power intensity.

These features, currently still under investigation, suggest a potential use of the device for optoelectronics applications.

Primary author: ARAMO, Carla (NA)

Co-author: AMBROSIO, Michelangelo (NA)

Presenter: ARAMO, Carla (NA)

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