



# CMOS LC Voltage Controlled Oscillator Design Using Multiwalled and Single-Walled Carbon Nanotube Wire Inductors

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We have utilized our Multiwalled Carbon NanoTube (MWCNT) and Single-Walled Carbon NanoTube (SWCNT) bundle interconnects model in a widely used  $\pi$  model to study the performances of MWCNT and SWCNT bundle wire inductors and compared these with copper (Cu) inductors. The calculation results show that the Q-factors of Carbon NanoTube (CNT) wire (SWCNT bundle and MWCNT) inductors are higher than that of the Cu wire inductor. This is mainly due to much lower resistance of CNT and negligible skin effect in carbon nanotubes at higher frequencies. The application of CNT wire inductor in LC VCO is also studied and the Cadence/Spectre simulations show that VCOs with CNT bundle wire inductors have significantly improved performance such as the higher oscillation frequency and lower phase noise due to their smaller resistances and higher Q-factors. It is also noticed that CMOS LC VCO using a SWCNT bundle wire inductor has better performance when compared with the performance of LC VCO using the MWCNT wire inductor due to its lower resistance and higher Q-factor.

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## 1. INTRODUCTION

It has been demonstrated that the carbon nanotube wire is very likely to replace the Cu interconnect in subnanometer CMOS technologies [Li et al. 2009]. It has also been

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