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RF Compact Models of Multilayer Graphene Nanoribbon and Multiwall Carbon Nanotube Interconnects

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Introduction

• The first two-year results of the European Research Project CATHERINE (http://www.catherineproject.eu) have demonstrated that a certain degree of control of the morphology and properties of multi-wall carbon nanotubes (MWCNTs) for nanointerconnect applications can be achieved through a suitable fabrication process that make use of a porous alumina membrane for the self-assempling of multiwall carbon nanotubes (MWCNTs) with desired characteristics.

• One of the main limitation of this approach is still the **compatibility with CMOS process**.

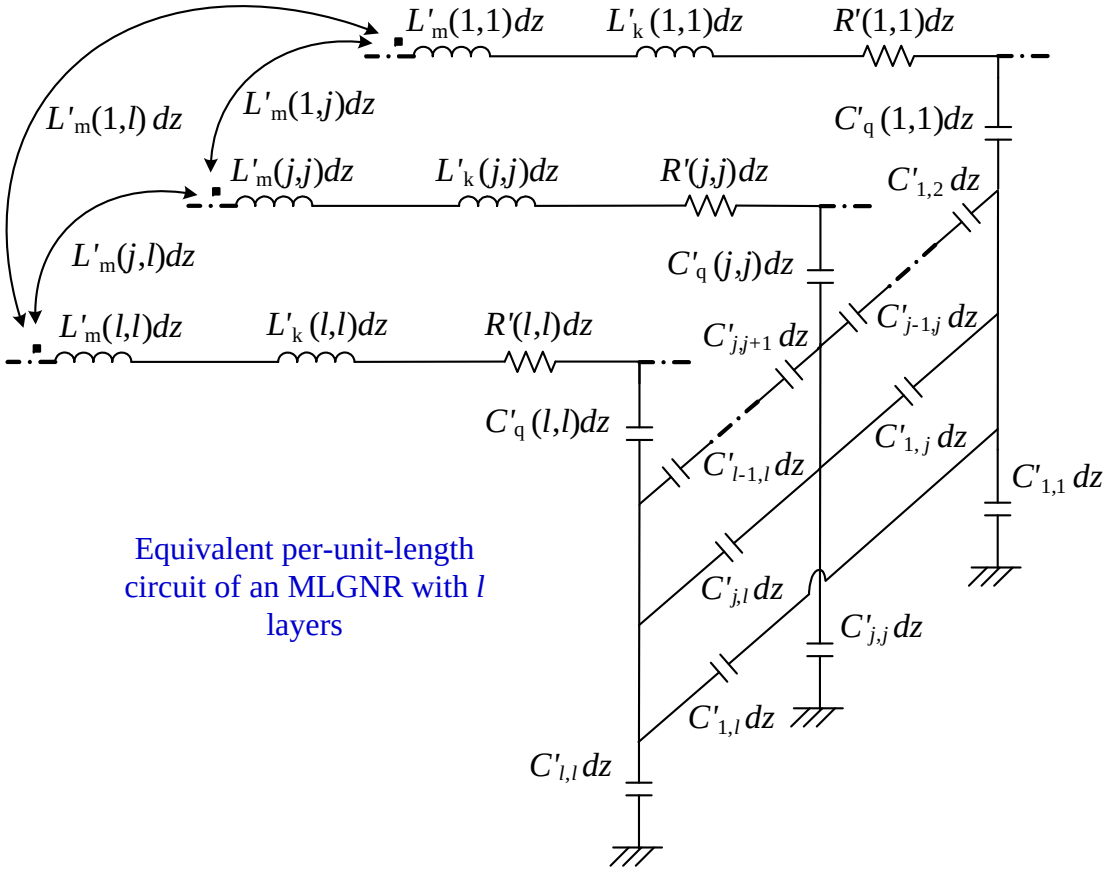
• It has been noted that **graphene** has the potential for circumventing many of the integration challenges that face CNT technology for fabricating high mobility planar devices.

• One of the main limitations in the practical use of graphene in nano-components is the capability of full **control of the functional properties in relationship with the structural characteristics and morphological nano-scale**.

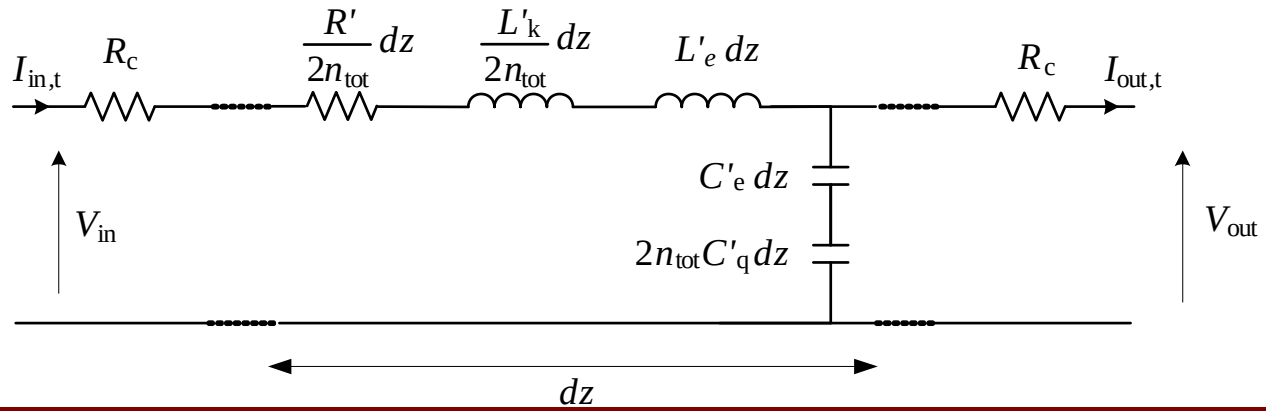
• **Radio-frequency (RF) and microwave (MW) simulation models for high-frequency operation prediction are needed for graphene-based device design and future integration in high-density packages.**

Scope of the work

- **The scope is to present compact models for the signal propagation and signal integrity analysis at radio frequency (RF) of nanointerconnects made either of multiwall carbon nanotubes (MWCNTs) or multilayer graphene nanoribbons (MLGNRs).**



Equivalent per-unit-length circuit of an MLGNR with l layers



Equivalent single conductor of an MLGNR interconnect

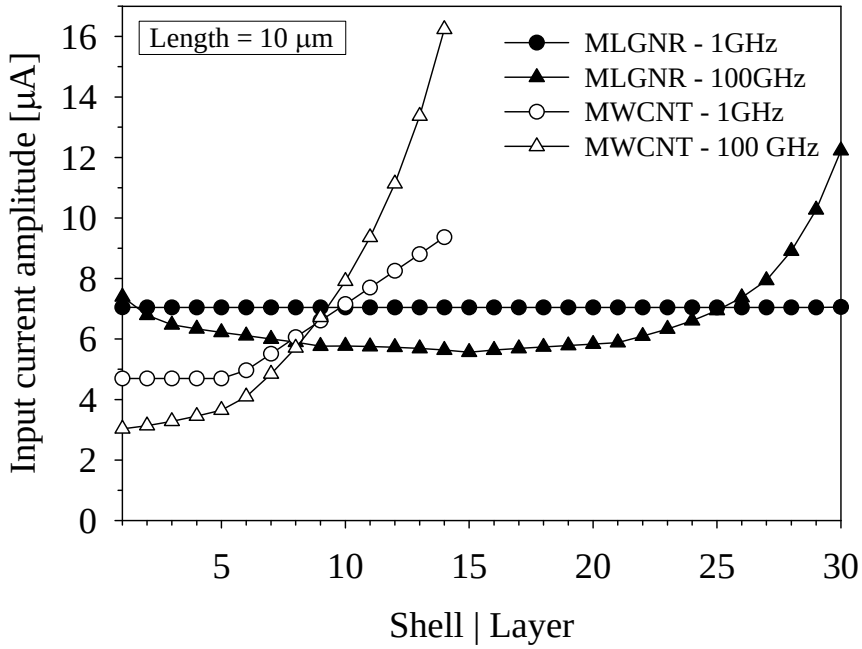
Summary

- **The multiconductor transmission line model of an MLGNR and MWCNT interconnect is proposed for the analysis of current distribution and signal propagation up to 100 GHz.**

- **The equivalent single conductor models are also developed in order to analyse the common mode propagation.**

- **The comparison of the RF performances of an MLGNR interconnect and an MWCNT is performed.**

- **An MLGNR interconnect has a higher current carrying capability than an MWCNT nanoline having the same dimension and configuration above the ground.**



Input current distribution amog all layers (30) of an MLGNR and among all shells (14) of an MWCNT at 1 GHz and at 100 GHz