Project: GRAPH-SIM (UAB, ICN2, Keysight Technologies)

GRAPH-SIM

GRAPH-SIM – Simulation environment for hybrid graphene-silicon CMOS integrated circuits

During the last decade a great variety of devices based on graphene have been experimentally demonstrated; notably, p-n junctions, varactors, transistors, and barristors. By combining these devices with passive components, innumerable circuits could be designed for digital, analog and radio frequency (RF) applications, preferably in the form of an integrated circuit (IC). It is hoped that such circuits can be integrated into the silicon platform with the aim of increasing IC functionality, thus exploiting the unique properties of graphene. In order to create such hybrid ICs that combine silicon technology with graphene technology, a simulation environment is required that allows calculating the electrical behavior of the circuits (including DC, AC response, transient analysis, and noise analysis) with a result consistent with experimental measurements. The availability of such an environment is a precondition of the manufacturing process. Given that such an environment already exists for silicon, our proposal is to take advantage of this advance and add the ability to simulate the circuits made on the graphene platform, including the hybrid simulation of the circuits on both platforms. The state of the art in compact models oriented to technology based on graphene considers the main physical effects. For the simulations to be realistic, various non-idealities must also be considered, such as the effects caused by the extrinsic network of the device, the effect of the charges trapped in the dielectric materials and in the interface with the graphene, the effect of self-heating, short channel effects, inertial effects of carriers, and the effect of low and high frequency noise (see Figure 1). The project is led by the UAB (experts in compact models of graphene devices), and has the collaboration of ICN2 (with extensive experience in the manufacture of graphene devices and circuits) and Keysight Technologies (a company recognized worldwide for offering simulation environments in various technologies).

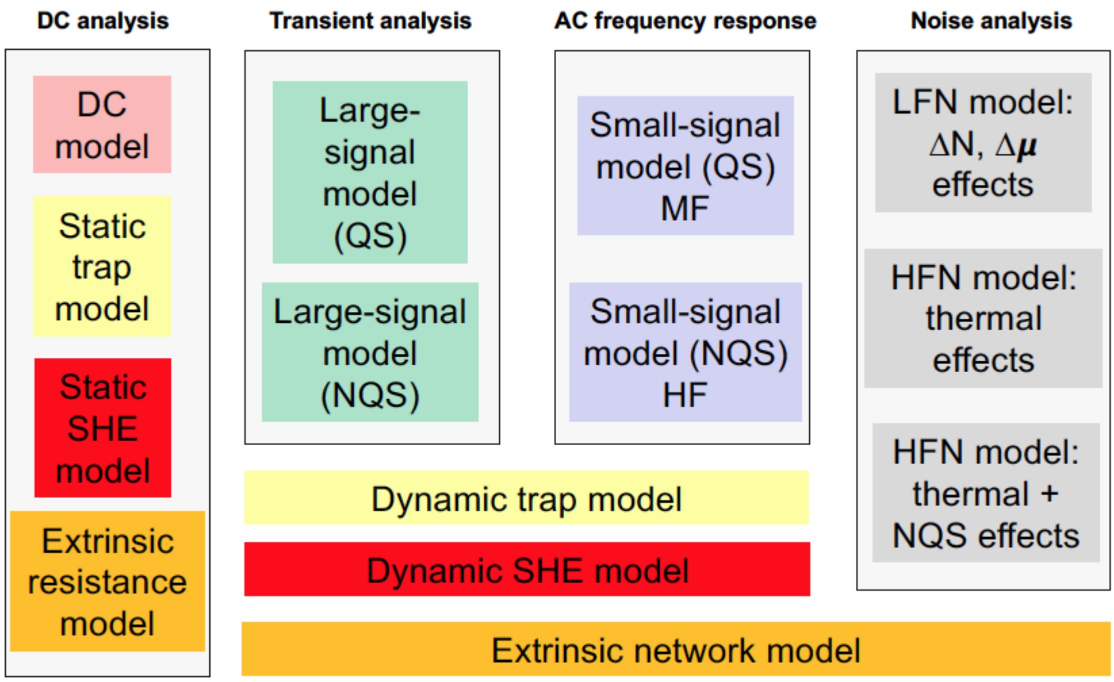

Fig. 1: The realization of a technology for simulating hybrid graphene-silicon circuits requires the development of compact models that capture the relevant physical effects for each type of circuit analysis: DC, transient, frequency response, noise. Acronyms used - SHE: self-heating, QS: quasi-static, NQS: non quasi-static, MF: medium frequency, HF: high frequency, LFN: low frequency noise, HFN: high frequency noise.

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