Motivations and objectives

Graphene → 2D honeycomb carbon crystal [1]

Unique electronic band structure: Linear Dirac spectrum

Unusual optical conductivity → Particularly attractive optical properties:

- TM Graphene surface plasmons: low loss, high confinement
- TE Graphene surface plasmons: very difficult to excite in practice
- Electrically tunable conductivity

Various plasmonic applications in the IR and the THz regions of the EM spectrum [2,3]

Physical System and Methods

The generic structure

In each medium \( \Omega \), the fields can be expressed as:

\[
U_{q}(x,z) = \sum_{q} U_{n,q}(z) e^{i\omega x} \quad q \in \{0, ..., N + 1\}
\]

The General solution:

\[
U_{n,q}(z) = \begin{cases} \epsilon_{eq}(z) & \text{TE polarization} \\ \eta_{eq}(z) & \text{TM polarization} \end{cases}
\]

Boundary conditions → S-matrix Algorithm

Codes validations

FMMASR (Adaptive Spatial Resolution)

Stretched coordinates

\( x = f(u) \)

High Resolution

Discontinuity Points

Absorption

Convergence

Horizontal Strips

Vertical Strips

Results

Conclusions

The former objective of the PhD work is achieved: the construction of general versatile and efficient codes for the modeling and simulation of graphene-based nano-devices. Furthermore, we discovered a problem with the FMM in the case of pathological vertical gratings and proposed an efficient solution through the use of the ASR concept. We are now ready to begin the next step consisting in the exploration of graphene plasmonic devices.

Bibliography