Graphene transistors for future high frequency and flexible electronics (MCCX02-19-02)

Background
The frequency range of electronic components is continuously being pushed towards higher frequencies driven, in particular, by requirements of higher data transfer rate of the next generations of communication systems. The unique property of intrinsically high carrier velocity in graphene enables the possibility of much faster electronics than with traditional semiconductors. Combination of the high carrier velocity with graphene flexibility, offers many novel exciting applications. Below are the images of two examples of advanced devices, which are recently developed and demonstrated in our Terahertz and Millimeter Wave Laboratory: i) 200 GHz receiver integrated on Si and ii) flexible THz detector, both based on graphene field-effect transistors (GFETs). However, realization of the competitive high frequency GFETs is hindered, by several intrinsic and extrinsic factors, e.g. zero-bandgap phenomenon in monolayer graphene, extrinsic scattering of charge carriers, and relatively high contact resistance of the graphene-metal junctions. Therefore, design, materials and technology of the GFETs have to be developed to address the challenges and fully exploit the unique properties of graphene in the next generation of high frequency and flexible electronics.

Project description
The objective of the project is development and experimental demonstration of the GFETs with advanced performance suitable for future wide bandwidth and wearable electronics. The project will be a part of the Graphene Flagship Core 2, which is the EU’s largest research initiative, tasked with taking graphene from laboratories into the market.

Activities
The content of the work is tentative and will include some of the following specific tasks: study of literature in the field of graphene for high frequency and flexible electronics; learning e-beam lithography technique and thin film processing; design of GFETs optimized for low-noise RF amplifiers; fabrication of GFETs on Si and/or polymer substrates; dc and microwave on-wafer characterization of the GFETs; analysis and interpretation of results.

Group size
3-4 students

Målgrupp
E, F, Kf, K, or corresponding GU programs

Handledare
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Integrated 200 GHz GFET mixer and amplifier
Keynote talk at IRMMW-THz 2018 by M. Bonmann et al.

Flexible GFET THz detectors
Mobile World Congress, Barcelona, 2018