TESIS DOCTORAL

Silicon- and Graphene-based FETs for THz technology

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This Thesis focuses on the study of the response to Terahertz (THz) electromagnetic radiation of different silicon substrate-compatible FETs. Strained-Si MODFETs, state-of-the-art FinFETs and graphene-FETs were studied.
Room temperature detection under excitation of 0.15 and 0.3 THz as well as sensitivity to the polarization of incoming radiations were demonstrated using Si-MODFET and Si-FINFETs devices. Excellent performance were obtained by both devices strained-Si MODFETs (Resp=75 V/W, NEP= 0.06 $nW/Hz^{0.5}$) & FINFETs (Resp=0.66 kV/W, NEP=0.05 $nW/Hz^{0.5}$).
A large part of the Thesis was devoted to the fabrication and characterization of Graphene-based FETs. A novel transfer technique and an in-house-developed setup were implemented in the Nanotechnology Clean Room of the USAL and described in detail in this Thesis. The newly developed transfer technique enables to encapsulate a graphene layer between two flakes of h-BN. Raman measurements confirmed the quality of the fabricated graphene heterostructures and, thus, the excellent properties of encapsulated graphene. The asymmetric dual grating gate graphene FET (ADGG-GFET) concept was introduced as an efficient way to improve the graphene response to THz radiation. High quality ADGG-GFETs were fabricated and characterized under THz radiation. DC measurements confirmed the high quality of graphene heterostructures as it was shown on Raman measurements. A clear THz detection was found for both 0.15 THz and 0.3 THz at 4K when the device was voltage biased either using the back or the top gate of the G-FET. Room temperature THz detection was demonstrated at 0.3 THz using the ADGG-GFET. The device shows a Responsivity and NEP around 2.2 mA/W and 0.04 $nW/Hz^{0.5}$ respectively at respectively at 4K.
It was demonstrated the practical use of the studied devices for inspection of hidden objects by using the in-house developed THz imaging system.

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