

Graphene/hBN - based varactor for novel sub-THz phase shifter.

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The mm-wave and terahertz (THz) frequency ranges are gaining much attention recently due to their high applicability, which creates a need for the development of the devices operating in abovementioned frequency ranges. One among the most important elements of such THz devices (e. g. Phase shifters) are varactors (variable capacitors), that allow tuning of the system via electrically-induced capacitance shift. In [1], the carbon nanotubes (CNTs) MicroElectroMechanical System (MEMS) varactor is described.

The device consists of series of etched trenches with metallized bottoms structuring the bottom electrode. On top of the trenches, the layer of CNTs is placed, serving as a top electrode. When voltage is applied between the top/bottom electrodes, the electrically-formed force causes the nanotube layer to bend towards the bottom electrode resulting in distance reduction that in final increases the capacitance.

However, CNTs are known from changing the capacity by themselves when exposed to various environmental conditions like temperature variation, humidity or illumination.

Here, we present the new type of the varactor fabricated upon silicon/SixNy platform with use of carbon-based metamaterials. The design of the structure is inspired by the one reported in [1]. However, in our approach, graphene (GR) is used as a top electrode, since it seems to be more stable and immune against external environment conditions. Further stability improvement is achieved by covering GR with PMMA protective layer. To avoid shorting between GR and bottom electrode an hBN insulating layer was placed under GR.

We present the characterisation measurements of the metamaterial layers used in our device. Finally, the electrical characterisation of working device is presented including I - V and C - V characteristics, which appear to be linear. The tunability of our devices seems to be of the order of few hundred pF/V.

[1] A. A. Generalov et al., Nanotechnology 26, 045201 (2015).

Primary author(s) : HARAS, Maciej (CENTERA Laboratories, Institute of High Pressure Physics PAS, Warsaw, Poland and CEZAMAT, Warsaw University of Technology, Warsaw, Poland); Dr DRÓŹDŹ, Piotr (CENTERA Laboratories, Institute of High Pressure Physics, PAS); Mrs PRZEWŁOKA, Aleksandra (CENTERA Laboratories, Institute of High Pressure Physics PAS, Warsaw, Poland; Institute of Optoelectronics, Military University of Technology, Warsaw, Poland)

Co-author(s) : Mr SŁOWIKOWSKI, M. (CEZAMAT, Warsaw University of Technology, 02-822 Warsaw, Poland); Mr FILIPIAK, M. (CEZAMAT, Warsaw University of Technology, 02-822 Warsaw, Poland); LYUBCHENKO, Dmitry (CENTERA Laboratories, Institute of High Pressure Physics, PAS)

Presenter(s) : Dr DRÓŹDŹ, Piotr (CENTERA Laboratories, Institute of High Pressure Physics, PAS)

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