Tailoring of CVD graphene properties by functionalization and doping

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This work demonstrates the possibility to adjust the optical and electronic properties of graphene by its functionalization by different impurities. The graphene synthesis, the functionalization process, characterization methods and analysis of achieved results are presented in this work [1, 2].
In the course of the work, experiments were performed on the functionalization of CVD-graphene using a non-destructive method of gas-phase deposition of substances at a temperature close to the boiling point of the substance. The functionalization of graphene with $Co(C_5H_5)_2$ resulted in an increase in the sheet resistance of the samples by more than 1.5 times; while the graphene functionalized by CuCl demonstrated the decreasing of sheet resistance by 2.4 times, while the functionalization of graphene with $FeCl_3$ reduced the sheet resistance by a factor of 3. In measuring the electronic properties of graphene, functionalized with various impurities, a change in the electronic structure of the initial graphene, namely, a shift of the Fermi level by 0.6 eV to the valence band for graphene doped with copper chloride, was shown.

References

[1] M. Rybin, A. Pereyaslavtsev, T. Vasilieva, V. Myasnikov, I. Sokolov, A. Pavlova, E.A. Obraztsova, A. Khomich, V. Ralchenko, E.D. Obraztsova "Efficient nitrogen doping of graphene by plasma treatment" // Carbon 96, 196-202 (2016).

[2] M. Rybin, V. Islamova, E.A. Obraztsova, and E.D. Obraztsova "Modification of graphene electronic properties via controllable gas-phase doping with copper chloride" // Applied Physics Letters 112, 033107 (2018).

Figures

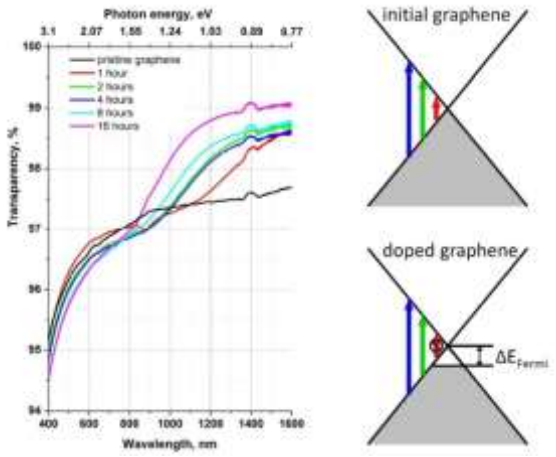

Figure 1: Optical transmission spectra of graphene doped with CuCl at 220°C during different times. (left figure) A scheme of electronic structure of initial graphene (right top figure) and p-doped graphene (right bottom) demonstrating a partial disappearance of optical absorption in the case of the Fermi level shift into the valence band. The laser excitation energy in Raman spectra is 1.96 eV.