Graphene on germanium substrate – expectations versus reality

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Graphene grown on germanium substrates is considered as a competitive material to the one grown on copper substrates. As its advantages one could enumerate the fact that CVD method can be applied to grow wafer scale graphene on germanium substrates, additionally due to mono crystallinity of the substrate, synthesis of graphene on Ge leads to a relatively well-oriented large-area layer and also graphene transferred from germanium substrates is free of copper contaminations [1-3]. Furthermore, graphene grown on germanium reveals conductivity, transparency, impenetrability comparable to those achieved in graphene synthesized on copper. All these qualities make graphene on germanium attractive in terms of potential application in CMOS technology.

However, recent literature reports show that it is not trivial to enhance electrical or structural properties of graphene/germanium system. Hydrogen intercalation of graphene and synthesis of graphene on differently crystallographically oriented germanium substrates do not boost graphene properties as one would expect [4, 5]. Additionally, it was observed that some regions of graphene/germanium system are susceptible to corrosion process, which can be observed at nano- and microscale [6]. Therefore, the electronic properties of such system are modified, especially around defected regions, deteriorating graphene properties.

In this work, we demonstrate recent research results on graphene/germanium system pointing out the progress and challenges.

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[1] I. Pasternak, M. Wesolowski, I. Jozwik, M. Lukosius, G. Lupina, P. Dabrowski, J.M. Baranowski, W. Strupinski, Scientific Reports, **6** (2016) 21773

[2] I. Pasternak, P. Dabrowski, P. Ciepielewski, V. Kolkovsky, Z. Klusek, J. M. Baranowski, W. Strupinski, Nanoscale, **8** (2016) 11241

[3] M. Lukosius, J. Dabrowski, J. Kitzmann, O. Fursenko, F. Akhtar, M. Lisker, G. Lippert, S. Schulze, Y. Yamamoto, M. A. Schubert, H. M. Krause, A. Wolff, A. Mai, T. Schroeder, and G. Lupina, ACS Appl. Mater. Interfaces, **8** (2016) 33786

[4] J. Judek, I. Pasternak, P. Dabrowski, W. Strupinski, M. Zdrojek, Applied Surface Science, 473 (2019) 203

[5] J. Sitek, I. Pasternak, J. Grzonka, J. Sobieski, J. Judek, P. Dabrowski, M. Zdrojek, W. Strupinski, Applied Surface Science **499** (2020) 143913

[6] P. Dabrowski, M. Rogala, I. Pasternak, P. Krukowski, J.M. Baranowski, W. Strupinski, I. Lutsyk, D.A. Kowalczyk, S. Pawłowski, Z. Klusek, Carbon, **149** (2019) 290