Graphene on Silicon Nanoscale

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The possibility of low-temperature synthesis of graphene on the surface of porous silicon (PS) is associated with the excess surface energies of nc-PS nanocrystallites ; the boundary interface nanocrystallties nc-PS / c-Si monocrystal matrix; the dangling bonds of silicon atoms of nanocrystallites skeleton nc-PS . This opens up new prospects for the development of methods for the low-temperature synthesis of graphene without metal catalysts for the decomposition of carbon precursors, including using the ALD method.
Keywords: porous silicon, energy, nanocrystal, dangling bonds, interface, skeleton, low-temperature synthesis, graphene.

The actuallity of developing low-temperature synthesis of graphene is associated with the development of flexible electronics based on organic polymers, which are planned to be done in the next 5 years [1]. Currently existing low-temperature (300–500 ° C) LPCVD- [2], PECVD- [3], REALD- [4] methods for the synthesis of graphene are either imperfect to obtain a stable and uniform large area of graphene, LPCVD [5], or possess the same drawbacks as the high-temperature CVD method for the synthesis of graphene on metal catalysts, high cost and energy consumption, PECVD, or complicated for large-scale application, REALD.
Recently, the possibility of low temperature <400 ° C synthesis of multilayer graphene [6] and few layer graphene, carbon graphene nanocomposite [7] on the surface of porous silicon PS has been shown. The high energy activity of PS is associated with the catalytic activity of nanosized silicon nc-PS for low-temperature decomposition of a carbon precursor [6], and also with previously known quantum-size effects such as a decrease in the melting temperature of a crystal with a decrease in size [8], a change in the energy gap of nanocrystals [9], and energy saturation dangling bonds of Si atoms of nanocrystallites of the skeleton nc-PSi [10]; the appearance of elastic deformation forces at the nanocrystal / c-Si matrix interface due to mismatch defects [11]. The possibility of synthesizing graphene on the PS surface without the use of metal catalysts can open up a new perspective for the integration of silicon and graphene electronics without metal interconnects [6], and the development of flexible electronics based on organic polymers using the ALD method [12].

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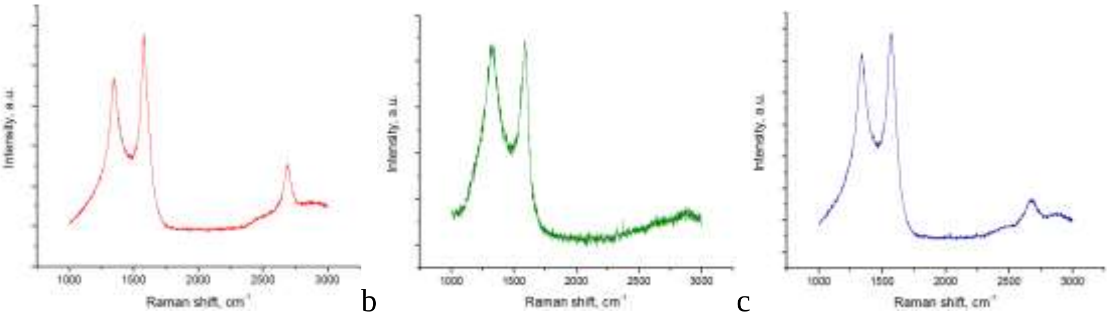

a b c

Figure 1: Raman spectra of samples a) PS <C> 350 ° C, b) PS <C> 500 ° C, c) PS <C> 1050 ^{o}C