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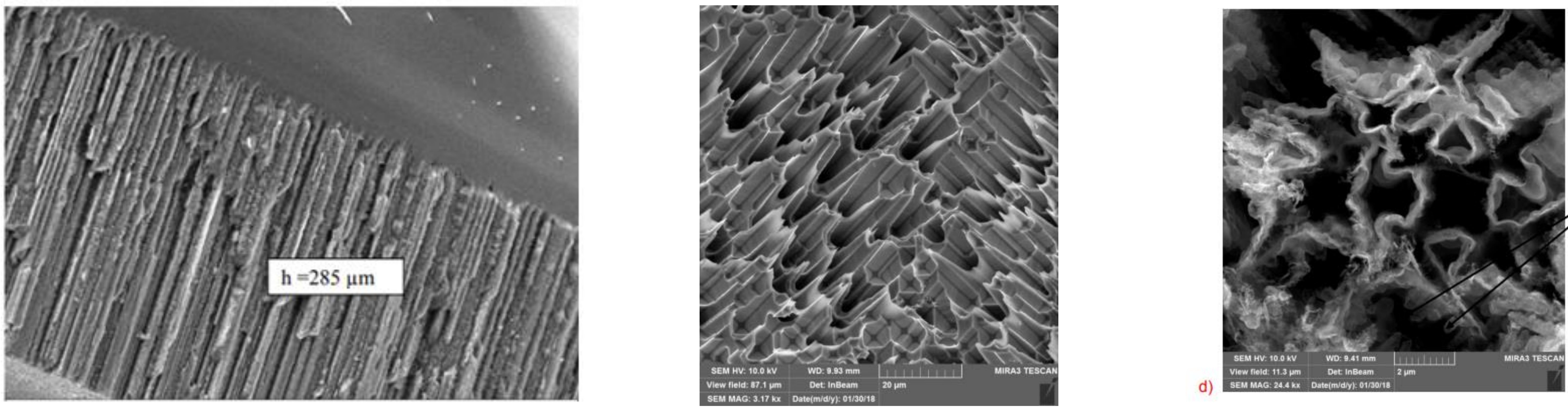
GRAPHENE ON SILICON NANOSCALE

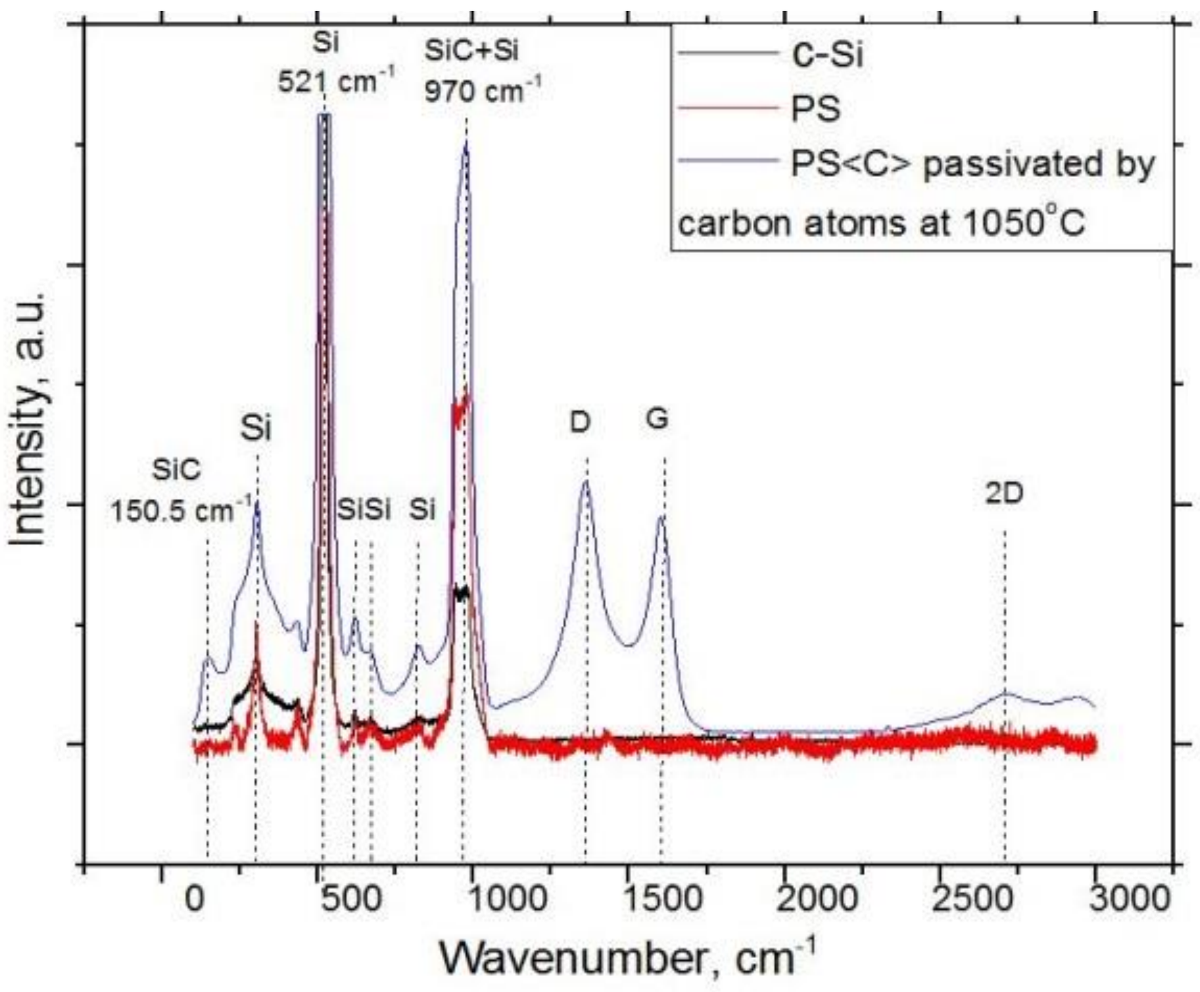
Kurbangali Tynyshtykbayev, Chistos Spitas, Konstantinos Kostas, Zinetula Insepov

Abstract. The energy of low-temperature synthesis of graphene on the surface of nanoporous silicon (nc-PS) is considered. It was shown that the energy of low-temperature synthesis of graphene on nc-PS is due to the excess energies of the nanocrystal surface, the interfaces of the nanocrystal nc-PS / c-Si monocrystal matrix, and the free dangling bonds of silicon atoms of nanoscale silicon grains in the skeleton of porous silicon. This opens up a new perspective for the development of methods for the low-temperature synthesis of graphene without metal catalysts for the decomposition of carbon precursors, including the use of the ALD method.

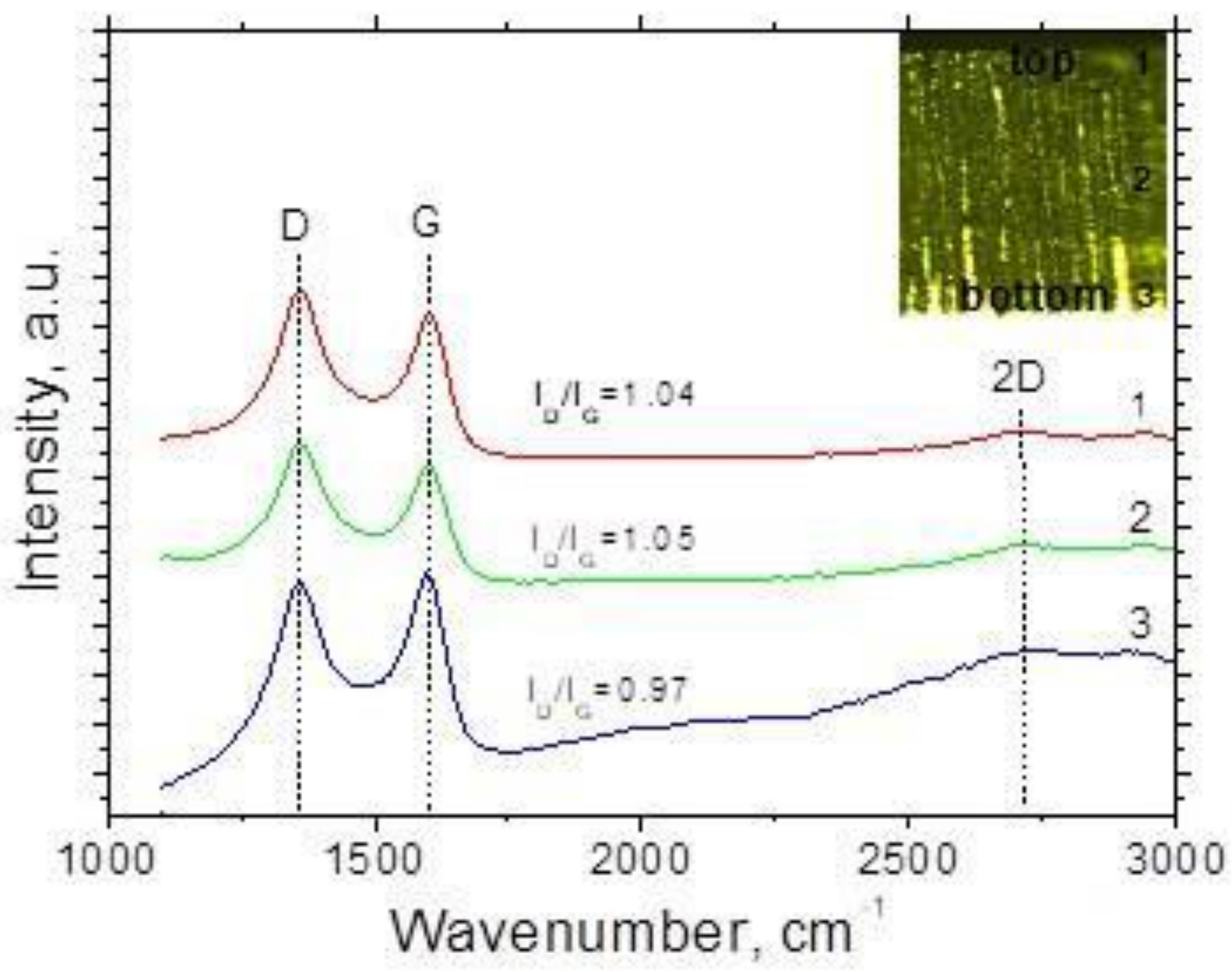
Keywords: porous silicon, energy, nanocrystal, dangling bonds, interface, skeleton, low-temperature synthesis, graphene.



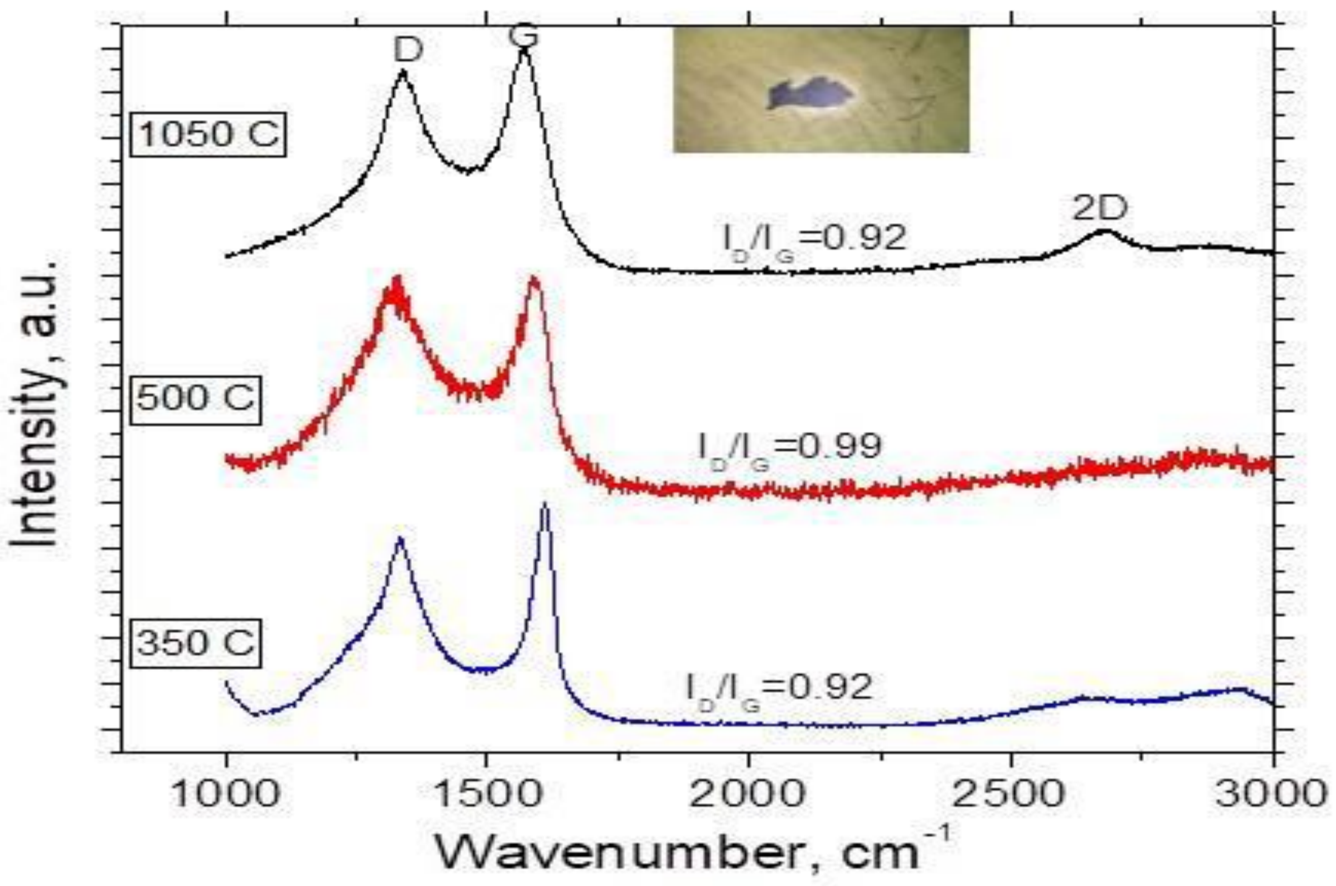
SEM images of porous silicon samples. Arrows indicate the Graphene layers on the surface of pores of skeleton PS



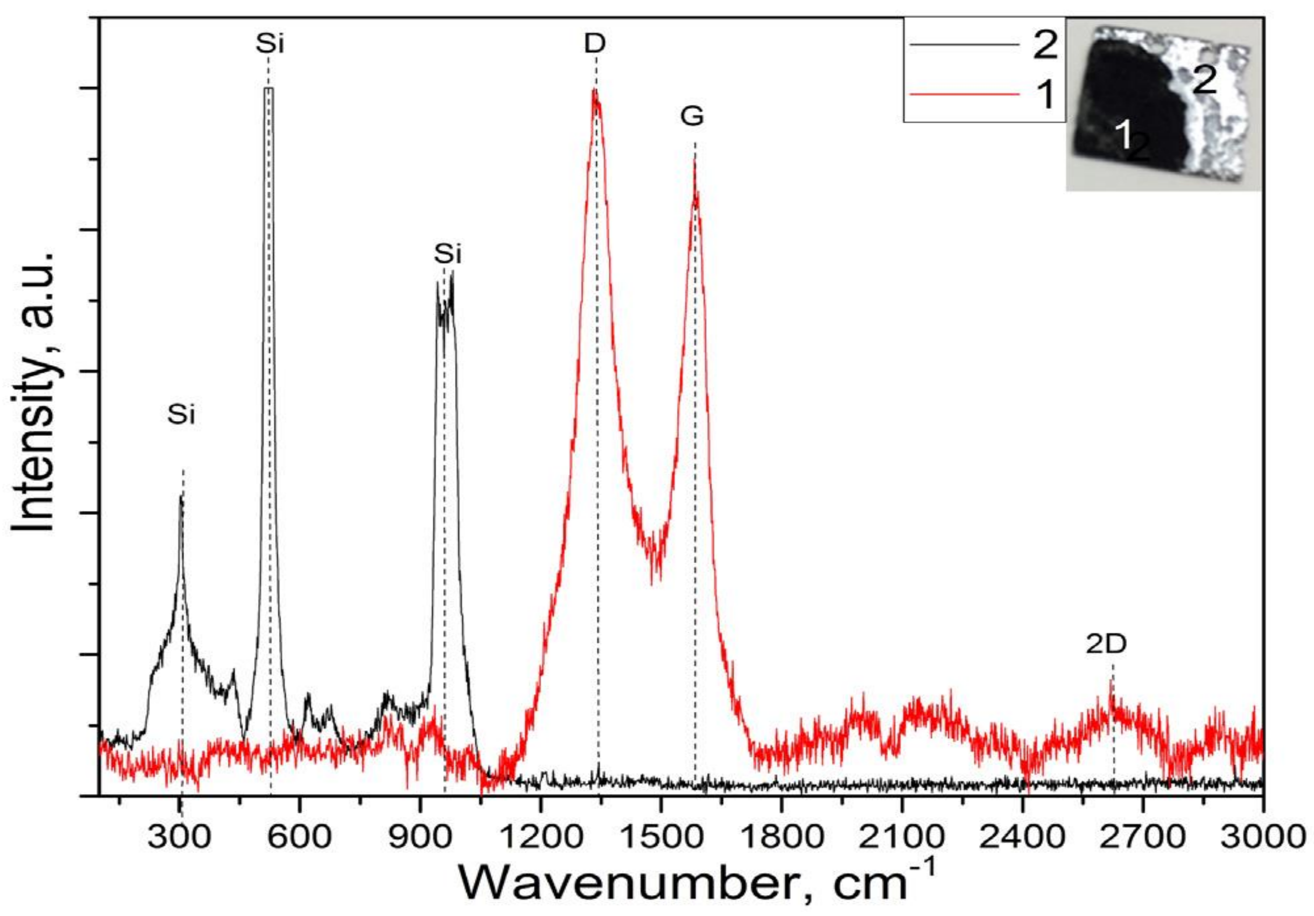
Raman spectra of samples of initial c-Si (black curve), PS without carbonization (red curve), and PS⟨C⟩ carbonized at 1050 °C (blue curve). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)



Raman spectra of the PS⟨C⟩ sample recorded from the end face: (1) top, (2) middle, and (3) bottom pore parts. The inset shows optical pattern of the cut face of the PS⟨C⟩ plate. The designations correspond to the regions where the spectra were recorded: “top” is the part open to the acetylene vapor admission, “bottom” is the pore bottom.



Raman spectra of the surface layer of porous silicon passivated by carbon atoms at various temperatures.



Raman spectra of the porous silicon sample carbonized at T=1050 °C after etching in hydrofluoric acid. The red line shows the spectrum of the porous surface, the black line presents the spectrum of the pore-free surface. The peaks of low intensity in the region 2500–3000 cm−1 are shown by arrows. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Conclusion. The possibility of low-temperature synthesis of graphene at T = 350 ° C experimentally by the example of carbonization of energy-saturated porous silicon nanocrystallites with an high energies of free dangling bonds of silicon atoms of the nanocrystallities nc-Ps and boundaries interface nc-PS /c-Si matrix skeleton shown.
It is opens up new prospects for integration graphene electronics with silicon electronics, without the use of metal bonds for the smooth connection of carbon and silicon nanostructures

CONTACT PERSON

Nazarbayev University,
Kabanbay batyr av. 53,
Nur Sultan, Kazakhstan 010000
insepov@nu.edu.kz

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