Organ pipes

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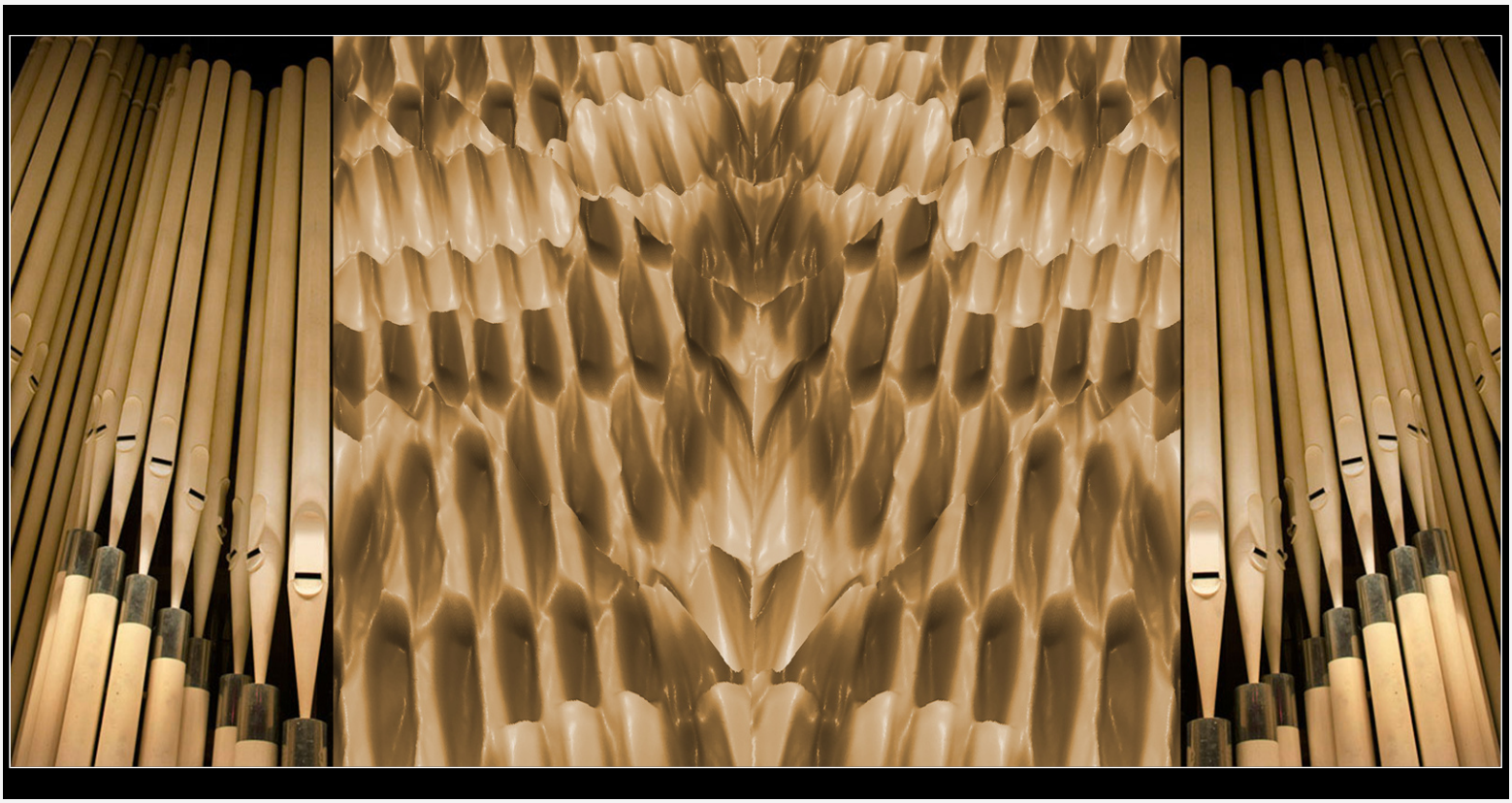

In the central part of the picture presented is an unusually-looking surface of monocrystal of highly oriented pyrolytic graphite (HOPG), which arose as a result of mechanical cleavage. As a rule, cleaving this sort of graphite leads to formation of plane atomically smooth areas with sizes from several hundreds of nanometers to several microns. In the case in question however, during the cleavage some of the graphite layers formed a previously unobserved multilayer system of parallel spatial cavities (channels) which plane facets/walls apparently represent graphene sheets. The spatial cavities have parallelogram cross-section. The width of the large facet of the cavity makes 30 nm, small – 20 nm. The depth of the cavity is 8 nm. The thickness of the facet/wall is about 1 nm.

The practical importance of the observed phenomenon consists in the fact that rather complicated multilayer hollow 3D nanostructures of graphene do exist in principle and that they can be fabricated by using original graphite, i. e., a “stack” of plane graphene sheets, as a raw stock. It is well known that graphene is especially worthwhile being a thin (literally atomic) graphite layer completely separated from a substrate. Otherwise, this material degenerates into regular, yet very thin, carbon film, which can be easily fabricated by the contemporary well-developed methods of molecular-beam epitaxy (MBE) or chemical vapor deposition (CVD).

The image of the graphene nanostructure was obtained in the Institute of Physical Problems named after F. V. Lukin on a scanning tunneling microscope (STM) Solver™ P4 (NT-MDT Co., Russian Federation) in ambient conditions. Bias voltage was 50 mV, tunnel current was 890 pA. A mechanically cut NiCr wire was used as a tip. Scan size is 290×260 nm, height range is 12 nm. The author is grateful to Oleg E. Lyapin for his help in preparation of this artwork.