Graphene on Ir/YSZ/Si(111): low-cost synthesis and electronic properties

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Abstract

Graphene is seen as potential successor to silicon [1,2] due to its high charge carrier mobility, which could facilitate ultra high speed electronic devices.
Chemical vapour deposition (CVD) synthesis of graphene on single crystal metal surfaces [3] represents a widely used approach, which offers scalable methods for the large-scale production of high-quality graphene layer but it is severely limited by the high cost.
The scalable approach of graphene formation reported here provides an important route to the low cost mass production of epitaxial graphene on silicon-based multilayer substrates, which are already available in 4-inch wafers [4].
We have investigated the selective formation of graphene on single crystal Ir(111) films, grown heteroepitaxially on Si(111) wafers with yttria stabilized zirconia (YSZ) buffer layers, using several hydrocarbons and substrate temperatures during CVD synthesis. This surface-induced chemical growth mechanism has been investigated using low-energy electron diffraction (LEED), X-ray photoelectron spectroscopy (XPS), near edge X-ray absorpion fine structure (NEXAFS), and angle-resolved photoemission spectroscopy (ARPES), showing that monolayer graphene grown on Ir(111) films on YSZ/Si(111) is comparable in surface quality to graphene/Ir(111) bulk single crystals and it represents a good way for an up-scalable and low cost synthesis of graphene. Using higher CVD temperatures, ARPES clearly shows double bands characteristic of bilayer graphene formation.

References

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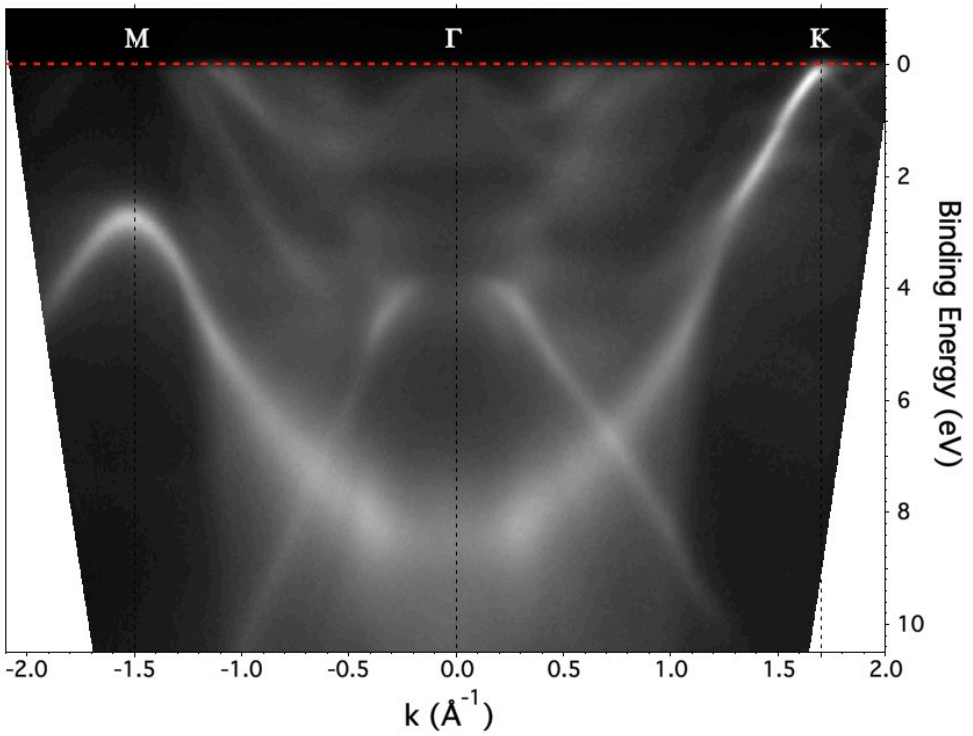

Figure: ARPES map of monolayer graphene on Ir(111)/YSZ/Si(111), acquired at RT, using 34 eV photon energy and horizontal polarization.