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Drastic reduction in the growth temperature of graphene on Cu substrates via enhanced London dispersion force JIN-HO CHOI, ZHANCHENG LI, PING CUI, XIAODONG FAN, CHANGGAN ZENG, ZHENYU ZHANG, University of Science and Technology of China — London dispersion force is ubiquitous in nature, and is increasingly recognized to be an important factor in a variety of surface processes. Here we demonstrate unambiguously the decisive role of London dispersion force in non-equilibrium growth of ordered nanostructures on metal substrates using aromatic source molecules. Our first-principles based multi-scale modeling shows that a drastic reduction in the growth temperature, from ∼1000 °C to ∼300 °C, can be achieved in graphene growth on Cu(111) when the typical carbon source of methane is replaced by benzene or p-Terphenyl. The London dispersion force enhances their adsorption energies by about (0.5-1.8) eV, thereby preventing their easy desorption, facilitating dehydrogenation, and promoting graphene growth at much lower temperatures. These quantitative predictions are validated in our experimental tests. The general trends established are also applicable in graphene growth using other aromatic carbon sources, and more broadly in molecular assembly and synthesis of surface-based nanostructures.

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