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Resumen

The development of advanced carbon nanomaterials, including graphene, can be traced back to the discovery of benzene, the archetypal aromatic molecule whose unusual properties puzzled nineteenth-century chemists. In 1825, Michael Faraday isolated benzene while studying the liquid produced during the compression of oil gas. He initially named the compound “bicarburet of hydrogen,” and its empirical formula, C6H6, was established several years later. The exceptional stability of benzene challenged the prevailing understanding of unsaturated hydrocarbons until August Kekulé proposed its cyclic structure in 1865. This model was definitively validated in 1925 through X-ray diffraction studies carried out by Kathleen Lonsdale.

This presentation explores the key milestones that led to the discovery and structural determination of benzene and follows the evolution of increasingly complex aromatic architectures derived from it. Attention is given to graphene, the first isolated two-dimensional (2D) material, whose extraordinary electronic, mechanical, and thermal properties sparked the emergence of an entire family of atomically thin materials.

The journey from benzene to graphene can also be appreciated through modern surface-assisted synthesis, which enables the fabrication of atomically precise nanographenes. These molecular nanostructures can be directly characterized using scanning probe techniques such as STM (Scanning Tunneling Microscopy) and nc-AFM (non-contact Atomic Force Microscopy). Remarkably, nc-AFM imaging with functionalized tips provides submolecular resolution, allowing individual benzene rings and even the bonding framework within nanographenes to be visualized in real space. Such capabilities offer an unprecedented connection between the molecular origins of aromaticity and the atomic structure of graphene-related materials. Graphene itself has been celebrated as a “gift from the gods,” reflecting both its scientific significance and its transformative impact on nanoscience.