# Luminescence Phenomena of Carbon Dots derived from Citric Acid

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Carbon dots (CDs) have attracted enormous scientific interest due to their tunable photoluminescence, low toxicity, and broad application potential in sensing, bioimaging, and photocatalysis. For many years, the origin of their luminescence remained a subject of intense debate, with proposed mechanisms involving quantum confinement effects, surface states, and molecular emissive centers. A major breakthrough in the field was the discovery that numerous highly fluorescent molecular species can be generated alongside carbonaceous nanoparticles during the synthesis of CDs from citric acid and amine-containing precursors.

This presentation will provide a historical overview of the development of the molecular fluorophore concept in carbon dots, highlighting key milestones that transformed the understanding of their photophysical properties. Particular attention will be devoted to citric acid-derived systems, in which molecular fluorophores have been identified as dominant contributors to fluorescence emission.

The contribution of our research group to this field will be discussed, including the synthesis, isolation, structural elucidation, and photophysical characterization of several citric acid-derived fluorophores [1-7]. Furthermore, the role of these fluorophores in explaining the optical properties of carbon dots, as well as their potential applications as standalone fluorescent dyes and photocatalysts, will be presented. Collectively, these findings support the view that molecular fluorophores constitute a fundamental class of emissive species in many citric acid-derived carbon dot systems and provide a framework for the rational design of next-generation fluorescent materials.

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