

Morphology And Electronic Properties Of Incipient Soot By Scanning Tunneling Microscopy And Spectroscopy

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Abstract

Soot nucleation is one of the most complex and debated steps of the soot formation process in combustion. In this work, we used Scanning Tunneling Microscopy (STM) and Spectroscopy (STS) to probe morphological and electronic properties of incipient soot particles formed right behind the flame front of a lightly sooting laminar premixed flame of ethylene and air. Particles were thermophoretically sampled on an atomically flat gold film on a mica substrate. High-resolution STM images of incipient soot particles were obtained for the first time showing the morphology of sub-5 nm incipient soot particles. High-resolution single-particle spectroscopic properties were measured confirming the semiconductor behavior of incipient soot particles with an electronic band gap ranging from 1.5 to 2 eV, consistent with earlier optical and spectroscopic observations.