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Flame structure and chemiluminescence in premixed flames. JOSE GRANA-OTERO, SIAMAK MAHMOUDI, University of Kentucky — The quantitative use of chemiluminescence requires the knowledge of the relationship between the concentration of excited species with flame properties such as the equivalency ratio, the burning rate or the heat release rate. With the aim of rigorously finding from first principles these relations we have analyzed, numerically and analytically, the distribution of the excited species OH^* and CH^* in steady hydrogen and methane planar premixed flames. Their mass fractions turn out to be extremely small; thus, a kinetic mechanism describing their dynamics in the flame can be obtained by simply adding the kinetic mechanism describing the excitation and de-excitation to the mechanism of the base flame. Due also to their small concentrations, the excited species are in steady state, facilitating a simple analytical description. The analyses show that OH^*, both in hydrogen and methane flames, can be found broadly distributed downstream the preheat region, in a three-layer structure that is analytically described. The distribution of CH^* is much simpler, being always in equilibrium with CH, whose concentration is in turn proportional to that of CH_4. As a result, CH^* is confined to the methane consumption layer in lean flames, but broadly distributed in rich flames.

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