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Dynamics of HF(v,J) Chemiluminescence and Lasing by Infrared Hyperspectral Imaging

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Abstract: This paper presents results from a continuing investigation of mixing flowfields and optical gain profiles in HF chemical laser systems by infrared hyperspectral imaging. Chemiluminescent F + H2 reacting flowfields and chemical laser output beams are imaged at a series of wavelengths, 2.6 to 2.9 microns, by a low-order, spectrally scanning Fabry-Perot interferometer mated to an infrared camera. The resulting hyperspectral data cubes define the spectral and spatial distributions of the emission. High-resolution images can be processed to determine spatial distributions of the excited state concentrations of the product HF(v,J), as well as spatial distributions of gain on specific laser transitions. This paper describes the instrumentation and its application to detailed observations of reactant mixing and energy transfer in the product HF(v,J), using a low-pressure laboratory reactor developed at Physical Sciences, Inc. (PSI). The measurements confirm that the PSI reactor generates inverted populations of HF(v,J).

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