QUASI ONE-DIMENSIONAL MODEL OF A RING DIFFUSION
CW CHEMICAL LASER AND SOME OF ITS APPLICATIONS

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INTRODUCTION

The theoretical study of a ring model diffusion cw HF chemical laser (HF-CL) has shown the advantages of using such a system [1,2]. In contrast with the traditional (plane) model, the ring laser (Figure 1) includes a cylindrical nozzle unit consisting of a large number of small coaxial nozzles with alternating jets of oxidizer (F, F₂) diluted by helium and fuel (H₂). The chemically active jets run radially outward and mix in the direction of the z-axis.

The quasi one-dimensional model of a cw CL is based on the sheet flame concept [3,4]. The quasi one-dimensional model described allows us to show the multilevel character of active molecule radiation and thermal and gas-dynamic effects in the chemically active flows of diffusion lasers. The theory in References 3-5 concerns a nozzle unit of plane construction.

The aim of this work is to extend the quasi one-dimensional approach to the case of a nozzle unit of cylindrical construction. The energy characteristics of a ring HF laser with an unstable telescopic resonator consisting of torroidal mirrors will be calculated as an example.

THEORY

The Main Equations of the Quasi One-Dimensional Model

The active medium of a supersonic chemical HF laser with a cylindrical nozzle unit consists of a large number of periodically
Fig. 1. The principal scheme of ring diffusion HF laser with the unstable telescopic resonator: 1) the cylindrical nozzle unit; 2) and 3) resonator mirrors.

placed ring-form reaction zones. These zones result from fuel (H₂) diffusion into the oxidizer flow (F+He); fluorine diffusion (the heaviest component) into the H₂ flow may be neglected. In accordance with the sheet flame concept the reaction zones are divided from the injection zones of F + He flows by the flame surfaces $z_f(r)$, defined by the stoichiometry of fuel and oxidizer (Figure 2). The sheet flame height $z_f(r)$ defines the depth of reagent mixing in section r. Taking a phenomenological approach, we assume that the surface form $z_f(r)$ is known. The main equations of the quasi one-dimensional model of cw CL with the ring form of the active medium may be formulated using axial symmetry [5]; in this work, however, the cylindrical expansion of flow will be considered. Let r be the coordinate along the gas direction, z, along the system axis and $z_f(r)$, the sheet flame height. As the stoichiometric correlation