GAS FLOW AND CHEMICAL LASERS

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Edited by
Michele Onorato

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Michele Onorato
Polytechnic Institute of Turin
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PREFACE

This volume contains eight invited papers and seventy-three contributed papers presented at the Fourth International Symposium on Gas Flow and Chemical Lasers, which was held in Stresa, Italy, from September 13 to 17, 1984.

The purpose of the Symposium was to record and discuss current research developments and applications related to high power lasers. Papers were solicited from the entire spectrum of activities, including basic physics, aerothermodynamics, new laser media, laser design, diagnostic techniques, laser propagation, interaction phenomena, applications.

The Symposium was an opportunity for scientists and engineers representing all these disciplines to come together to report their recent work, to exchange ideas and to provide an up-to-date account of international progress in these fields.

The contributed papers were reviewed by the members of the Scientific Advisory Committee, who also took responsibility for formulating the program of invited lectures.

As editor I wish to express my appreciation and my gratitude to people and organizations that made this Symposium a success: the Members of the Scientific Advisory Committee, the Members of the Local Organizing Committee, the Sponsors and the Symposium Secretary. A grateful acknowledgement is expressed to Dr. M. Sandra Oggiano for assistance in the organization of the Symposium and publication of these proceedings.

Michele Onorato

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CHEMICALLY PUMPED ELECTRONIC TRANSITION LASERS

Petras V. Avizonis

Air Force Weapons Laboratory

Kirtland Air Force Base, New Mexico

For a number of years we have been examining the ability to partition the chemical reaction energy directly into electronic transitions. The obvious advantage with this approach is that energy, which comes basically from chemistry, is partitioned directly into electronically excited states rather than going through an electrical power generation step with its associated inefficiencies. The disadvantage of such pumping schemes is that the excitation energy is limited to that of the chemical bond, 3 to 4 ev. Thus, unless multiple collisions are invoked, only electronic states below 4 ev could be pumped by such energy partitioning.

A successful demonstration of such an approach has been the oxygen/iodine transfer laser. Oxygen molecules are produced from a chemical reaction directly in the a'Δ state with 100% quantum efficiency. This is a highly forbidden state (60 minutes radiative lifetime), and the only way that lasing can occur from such electronic energy reservoir is to transfer such energy to a radiating state. This occurs in the resonant transfer of energy to iodine atoms (the $^2P_{1/2}$ state) which has a weak magnetic moment and radiates 1.315μ photons (to the $^2P_{3/2}$ state).

The success of the O_2/I laser has an indicated "roadmap" for direct partitioning of chemical energy into electronic states. What has become evident both experimentally and from quantum mechanics is that for such partitioning to be successful, the desired electronic state in the product molecule has to be forbidden and the reaction pathway to such a product molecule/state has to be spin allowed. Under these conditions, and only