JOURNAL OF PROPULSION AND POWER
Vol. 12, No. 6, November–December 1996

Introduction to Arcjets and Arc Heaters: Research Status and Needs Special Section

THE need for improved space propulsion systems and hypersonic test facilities has driven the development of arcjet thrusters and arc heated wind tunnels. The higher exhaust velocity provided by arcjets can substantially reduce the propulsion system mass for space missions ranging from stationkeeping and orbit maintenance to orbit transfer and interplanetary injection. For this reason they are currently used for stationkeeping on four geosynchronous communications satellites, with many more on the way. Development of high performance arc heaters is required to provide test environments for next-generation combat aircraft, both manned and unmanned, which may operate at hypersonic speeds. Design and construction of hypersonic aircraft with speeds up to 4–5 km/s will be extraordinarily complex, and will require advanced test facilities for the new airframe and propulsion technologies. The fundamental similarities between arcjets and arc heaters, in which electric current is passed through the propellant or process gas to heat and accelerate it, lead to a range of common performance and reliability problems that result in reduced efficiency, increased erosion, and unacceptable levels of flow fluctuations and exhaust purity. To foster collaboration between scientists and engineers working in these two fields, Professor H. Krier of the University of Illinois helped organize a special session at the 1994 Plasmadynamics and Lasers Conference to discuss the status of research on arcjets and arc heaters. The readers of the *Journal of Propulsion and Power* owe Professor Krier a special vote of thanks for his efforts, which provided the impetus for the Special Issue that follows.

The papers contained in this Special Issue discuss the spectrum of approaches to the problem of achieving high-performance, reliable arcjets and arc heaters. The critical science and engineering issues that have to be addressed include the experimental and numerical study of nonequilibrium processes, electrofluid mechanics, arc instabilities, arc electrode attachment, material science, and thermal design. The difficulty in addressing these issues, and their strong, non-linear coupling, is responsible for the discrepancies between predictive models and experimental measurements. Excellent work from a wide range of organizations, reflecting dramatic progress in theoretical understanding and experimental capabilities, is found in all of the papers in this Special Issue.

The summary of progress reported in this Special Issue is, of course, not complete; it does, however, attempt to describe how treatment of the critical science issues associated with arcjet and arc heater operation leads to improved performance and reliability. Continued progress in both the scientific understanding and engineering applications of the technologies is to be expected given the large number of papers presented at recent Plasmadynamics, Aerospace Sciences, Joint Propulsion, and International Electric Propulsion Conferences. Readers of the *Journal of Propulsion and Power* should look for such papers in the near future.

Mitat A. Birkan
Air Force Office of Scientific Research

Roger M. Myers
NYMA Inc, at the NASA Lewis Research Center
Currently at Olin Aerospace Company

Guest Editors

Reviewers

Auweter-Kurtz, M.
Boyd, I.
Bufton, S.
Butler, W.
Capelli, M.
Cassady, R. J.
Choueiri, E. Y.
Curran, F.
Diamant, K.
Erwin, D.
Gallimore, A. D.
Goodfellow, K.
Hoskins, A. W.
Hruby, V.
Janson, S.
Keefer, D. R.
Manzella, D.
Martinez-Sanchez, M.
Micci, M.
Miller, T.
Park, C.
Polk, J.
Pollard, J.
Sankovic, J.
Sheppard, E. J.
Subramaniam, V.
Sutton, A.
Tilley, D.
York, T.
Zelesnik, D.