

## **Comparison Between CFD Simulations and Experimental Characterization of a Supersonic Micronozzle**

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This paper reports about the comparison between some simulation and experimental results obtained during the development of a supersonic micronozzle.

This experimental characterization follows the conceptual work and preliminary results presented by the author at the JPC 2000 [1], MST 2001 [2], AMST 2002 [3], with a tests in vacuum conditions of a new profile of micronozzle manufactured at AIST in Japan for a thrust of the order of 100 microN to 1 mN. While the previous works presented the behavior characterized only under atmospheric pressure, the present work approaches the measurement in vacuum and tries to observe the effect of the losses by means of CFD simulation of the flow through the nozzle and thrust measurement with a novel microbalance.

Although several authors claim the possibility to reach more than 50 s of specific impulse also on the micrometer scale of such kind of thrusters, the results of this works shows that the effect of the losses can reduce the performances on a substantial way and suggests that only a careful choice of design parameters allows to approach such efficiency values. The laminar and turbulent characteristics of the flow, analyzed in this paper explain how the losses in the nozzle affect the overall performances.

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### **References**

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- [2] G.Manzoni, L.Vaccari, E.Di Fabrizio, “Design and Prototyping of a highly integrated micropropulsion system for microsattellites attitude control” , in: MST2001, Düsseldorf (D), 2001
- [3] Francesco De Bona, Giulio Manzoni, Pierpaolo Miotti “Measurement system for mN forces” AMST 2002 – Udine

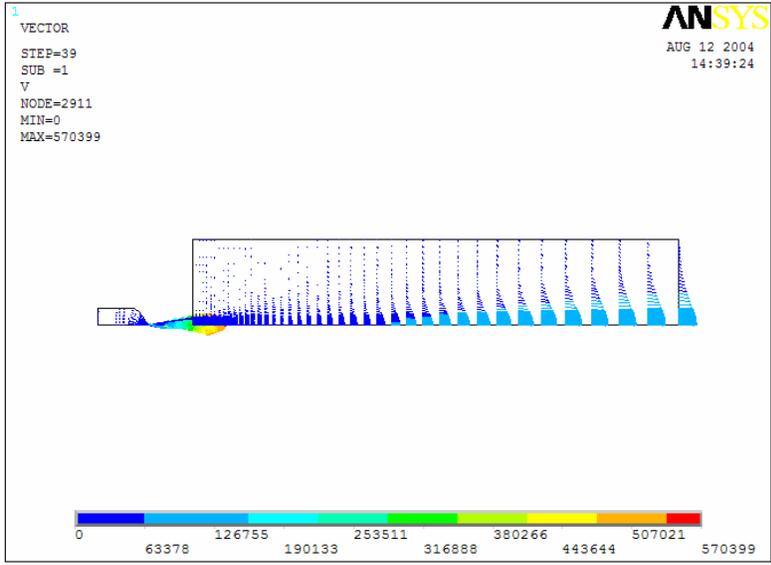


Fig. 1: CFD velocity plot in the micronozzle

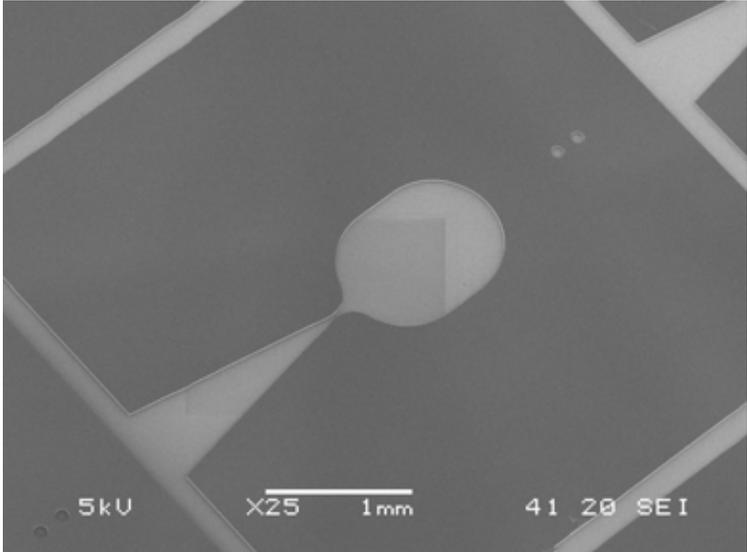


Fig. 2: SEM picture of the micronozzle

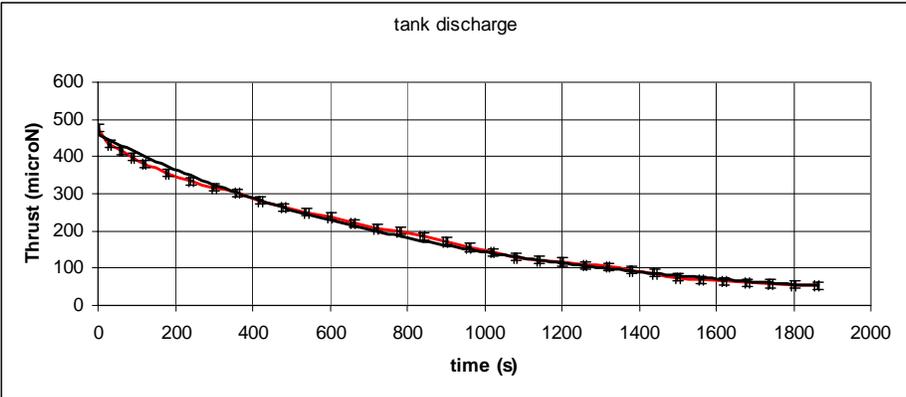


Fig. 3: Tank discharge profiles