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**BRAZILIAN PARTICIPATION IN THE INTERNATIONAL SPACE STATION**

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**Abstract**

Brazilian participation in the International Space Station (ISS) started in October 1997 under the responsibility of the National Institute for Space Research (INPE) and the Brazilian Space Agency (AEB). In this paper the Brazilian participation is presented together with its responsibilities and utilization rights. The construction of equipment in Brazil that will be delivered is described. The strategy for project implementation is discussed. Finally, the objectives of the scientific program created to manage the efforts for ISS utilization by the Brazilian scientific community will be presented, with special attention to materials science experiments.

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**PROPOSAL FOR LEAD-TIN-TELLURIDE CRYSTAL GROWTH BY  
VMS METHOD IN MICROGRAVITY AT ISS**

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Brazilian participation in the International Space Station (ISS) started in October 1997 under the responsibility of the National Institute for Space Research (INPE) and the Brazilian Space Agency (AEB). In this paper, the Brazilian participation is presented together with its responsibilities and utilization rights. The construction of equipment in Brazil that will be delivered is described. The strategy for project implementation is discussed. Finally, the objectives of the scientific program created to manage the efforts for ISS utilization by the Brazilian scientific community will be presented, with special attention to materials science experiments.

Brazil began its participation in the International Space Station program through a contract for the project, construction and engineering services for six components for the space station. Based in the costs of these equipments and services (US\$ 120 millions), it was established the Brazilian utilization rights, including the transport of the scientific and technological payloads.

This agreement gave origin to the creation, at INPE, of the Brazilian International Space Station Program (BISSP). The program is divide in two areas of activities: one directly linked to the industrial production of the equipments, and the other turned to the

scientific area that will use the Brazilian rights for the accomplishment of experiments in ISS.

The activities of this last area encloses the conception, specification, production, integration and operation of scientific payloads of Brazilian and interest.

In this framework, the Brazilian program has as one of its main objectives, to motivate the engagement of universities and research centers in the activities for the ISS utilization, identifying areas of scientific and technological interest, as well as proposing experiments to be developed.

The identification of the Brazilian experiments is based on the acquired utilization rights that will be, in its majority, accomplished in the parts manufactured in Brazil. The allocations of the experiments and their mass to be transported to ISS and back to ground, by

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the Space Shuttle, were defined in an agreement.

The mass to be transported is 1935 kg in ten years of use, and the equipment localization, inside and outside of the station, is a rack locker in the Express Locker, an adapter in the Express Pallet and two adapters in the Technological Experiment Facility -TEF, and 3% of the operation time of the earth observation window WOLF-2. Additionally, 0.45% of the American resources can be used by the Brazilian experiments. Besides, as several experiments cannot be made in the Brazilian equipments, negotiations such as selling or exchanging places and utilization time should be made.

The scientific and technological areas that will benefit from the ISS were not yet completely identified. The Brazilian Space Agency (AEB) and the Brazilian Academy of Science (ABC) are in charge of the selection process that will contemplate projects that had scientific and technological merit; that are inside the framework of Brazilian rights of utilization; that are presented by stable and well known groups and organizations; and that effectively need the ISS space environment for the experiments.

All ground research, equipment and space qualification has to be sponsored by the groups and AEB will pay for the transportation and operational costs in space.

A first step, sponsored by AEB, was taken in May 1999 by holding The First Brazilian Workshop about Microgravity at INPE. More than 20 projects from groups interested in having their experiments at ISS were presented. The projects ranged from protein to semiconductor crystal grow, as well as

from capillary pumps to combustion research.

Several groups were identified as potential candidates for doing microgravity experiments, based on their state of art ground researches.

It was clear that biological science proposals are, at this moment, the main concern of the scientific community, and only a few projects about materials processing were presented at the Workshop.

Among the materials processing proposals in the Workshop, there were a few in semiconductors and in diamond growth under microgravity conditions. The quantity was well below the known capacity of the universities and research institutes that work in this field in Brazil.

Due to the enormous political and budgetary difficulties posed to countries that do not have space platforms capable of carrying out microgravity experiments, the majority of the competent materials science groups never took real interest in this research area.

Up to now the Brazilian efforts in this area consists of a sounding rocket project (PSO Mission) that already has carried out several experiments in a few minutes of microgravity. It consists of surplus two stages rockets (SONDA III) that carry 50 kg of technological payloads in 500 km apogee parabolic orbits, the capsule being retrieved at the sea.

A second program is a multiple application satellite, developed in the framework of a French-Brazilian cooperation. With 100 kg mass and an elliptical equatorial orbit, it will carry 18 kg of scientific and technological payloads. Four experiments are scheduled, one of them making use of microgravity.

Another satellite constructed at INPE, the Brazilian Scientific Microsatellite (SACI-1), designed for multiple scientific and technological applications and carrying 28 kg of scientific payload, have stopped responding to telemetry a few minutes after orbit insertion.

In addition, two proteins grown experiments have flown on STS-83 and STS-84.

The schedule to start flying the Brazilian experiments at ISS is set to 2003-2004.

In this context, one of the main tasks that AEB and INPE will have in this time gap is to divulge the new microgravity experimental opportunity to the Brazilian scientific community.

The INPE's Material Laboratory, besides preparing its own microgravity projects for ISS, will be engaged in stimulating other materials research centers and universities.