Manufacturing & Prototyping

Fabrication of Single Crystal MgO Capsules

Lyndon B. Johnson Space Center, Houston, Texas

A method has been developed for machining MgO crystal blocks into forms for containing metallic and silicate liquids at temperatures up to 2,400 °C, and pressures up to at least 320 kilobars. Possible custom shapes include tubes, rods, insulators, capsules, and guides. Key differences in this innovative method include drilling along the crystallographic zone axes, use of a vibration minimizing material to secure the workpiece, and constant flushing of material swarf with a cooling medium/lubricant (water).

A single crystal MgO block is cut into a section ≈5 mm thick, 1 cm on a side, using a low-speed saw with a 0.004 blade. The cut is made parallel to the direction of cleavage. The block may be cut to any thickness to achieve the desired length of the piece. To minimize drilling vibrations, the MgO block is mounted on a piece of adhesive putty in a vise. The putty wad cradles the bottom half of the entire block. Diamond coring tools are used to drill the MgO to the desired custom shape, with water used to wet and wash the surface of swarf. Compressed air may also be used to remove swarf during breaks in drilling. The MgO workpiece must be kept cool at all times with water. After all the swarf is rinsed off, the piece is left to dry overnight.

If the workpiece is still attached to the base of the MgO block after drilling, it may be cut off by using a diamond cut-off wheel on a rotary hand tool or by using a low-speed saw.

This work was done by Lisa Danielson of Jacobs Technology for Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-25052-1

Inflatable Hangar for Assembly of Large Structures in Space

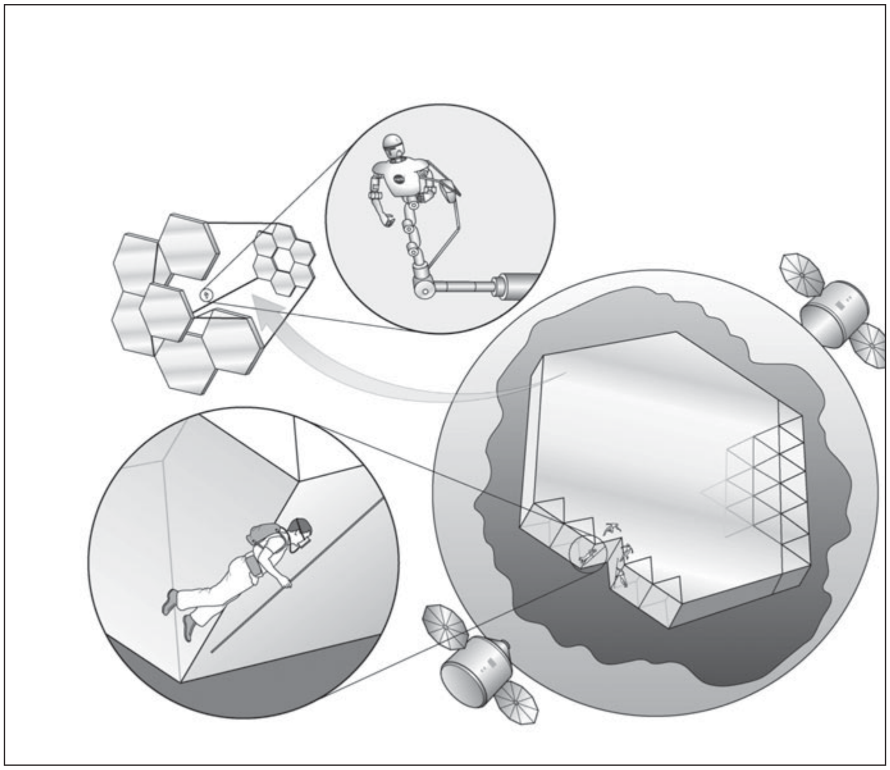
Such hangars may greatly increase the dexterity and performance of astronauts by operating in a shirtsleeves environment during the assembly process.

NASA's Jet Propulsion Laboratory, Pasadena, California

The NASA Human Space Flight program is interested in projects where humans, beyond low-Earth orbit (LEO), can make an important and unique contribution that cannot be reasonably accomplished purely by robotic means, and is commensurate with the effort and cost associated with human spaceflight.

Robotic space telescope missions have been conceived and launched as completed assemblies (e.g., Hubble) or as "jack-in-the-box" one-time deployments (e.g., James Webb). If it were possible to assemble components of a very large telescope from one or two launches into a telescope that was vastly greater in light-gathering power and resolution, that would constitute a breakthrough. Large telescopes on Earth, like all one-off precision assembly tasks, are done by humans. Humans in shirtsleeves (or cleanroom "bunny suits") can perform tasks of remarkable dexterity and precision. Unfortunately, astronauts in pressure suits cannot perform such dexterous and precise tasks because of the limitations of the pressurized gloves.

If a large, inflatable "hangar" were placed in high orbit, along with all the



An artist's rendering of the **Shirtsleeves Assembly Hangar**. At the lower right is a cutaway of the inflated fabric sphere that houses astronauts in oxygen masks and backpacks. The humans would work with a robot to accomplish the final telescope assembly.