Experimental Modeling of Sterilization Effects for Atmospheric Entry Heating on Microorganisms

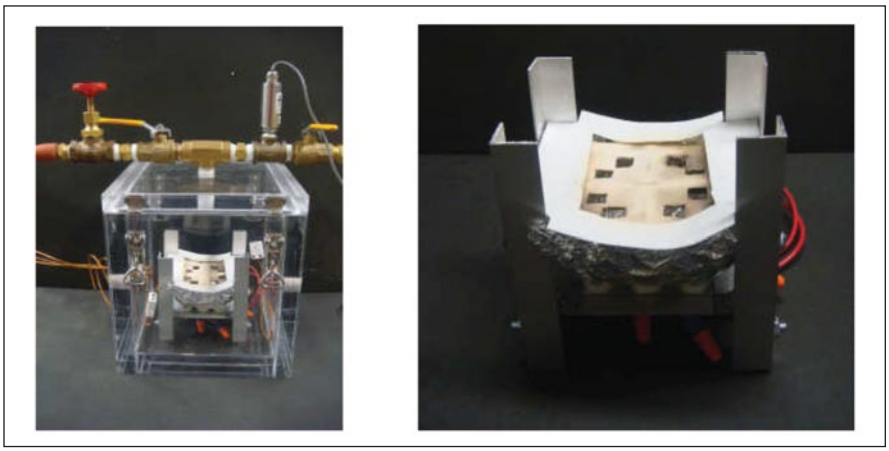
Silicon was chosen for sample coupons.

NASA's Jet Propulsion Laboratory, Pasadena, California

The objective of this research was to design, build, and test an experimental apparatus for studying the parameters of atmospheric entry heating, and the inactivation of temperature-resistant bacterial spores. The apparatus is capable of controlled, rapid heating of sample coupons to temperatures of 200 to 350 °C and above. The vacuum chamber permits operation under vacuum or special atmospheric gas mixtures.

A radiant heating system using tungsten-halogen lamps was chosen to heat the spores to the desired temperatures. This method of heating was preferred because there was no physical contact between the heater and the sample coupons, the radiant heat can be controlled more precisely than heating methods by conduction and convection, and halogen light bulbs are readily available. The design allowed for the bulbs to radiantly heat the backside of the sample coupons, avoiding possible sterilization of the spores by a method other than just heating, such as ultraviolet radiation.

The material chosen for the sample coupons was silicon, due to its favorable properties for this application. Silicon is chemically and biologically inert, and has very high thermal conductivity. Furthermore, silicon has high emissivity in the visible and near-infrared portion of the electromagnetic spectrum, and has a lower emissivity in the mid-infrared range. This means that the silicon coupons are able to absorb a significant portion of the radiation output by the halogen light bulbs, but not re-radiate much mid-infrared radiation at the sample temperatures. This unique property of silicon allows for the sample coupons to be heated very quickly and accurately using the radiant heat from the halogen light bulbs. Furthermore, due to the widespread use of silicon in the microelectronics industry, silicon was available in very thin wafers. The low thermal mass of the thin wafers helped them heat up very quickly.



The **Experimental Apparatus** consists of a vacuum chamber (left) and the stand for the silicon chips (right).

This work was done by Wayne W. Schubert and James A. Spry of Caltech; Paul D. Ronney and Nathan R. Pandian of the University of Southern California; and Eric Welder of Stanford University for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-48091

Saliva Preservative for Diagnostic Purposes

This preservative can be used in remote areas without refrigeration for at least two months.

Lyndon B. Johnson Space Center, Houston, Texas

Saliva is an important body fluid for diagnostic purposes. Glycoproteins, glucose, steroids, DNA, and other molecules of diagnostic value are found in saliva. It is easier to collect as compared to blood or urine. Unfortunately, saliva also contains large numbers of bacteria that can release enzymes, which can degrade proteins and nucleic acids. These degradative enzymes destroy or reduce saliva's diagnostic value. This innovation describes the formulation of a chemical preservative that prevents microbial growth and inactivates the degradative enzymes. This extends the time that saliva can be stored or transported without losing its diagnostic value. Multiple samples of saliva can be collected if needed without causing discomfort to the subject and it does not require any special facilities to handle after it is collected.

The preservative contains sodium dodecyl sulfate (SDS), ethylenediaminetetraacetic acid (EDTA), and Tris buffer. This preservative was developed to preserve saliva from astronauts during spaceflight without refrigeration to determine if virus DNA was present. Saliva with added preservative can be