Abbreviation	Polymer Name	Trade Name	Thickness
PE	Polyethylene	Alathon; Lupolen	2 mil
PET	Polyethylene terephthalate	Mylar A	2 mil
POM	Polyoxymethylene	Delrin; Celcon	4 mil
PS	Polystyrene	Lustrex; Polystyrol	2 mil
PP	Polypropylene	Profax; Propathene	20 mil
PMMA	Polymethylmethacrylate	Plexiglas; Lucite	2 mil
FEP	Fluorinated ethylene propylene	Teflon FEP	2 mil
PTFE	Polytetrafluoroethylene	Fluon; Teflon	2 mil
PCTFE	Polychlorotrifluoroethylene	Neoflon CTFE M-300	5 mil

Polymers Tested for atomic oxygen-altered hydrophilicity.

fluorinated polymer samples became significantly more hydrophilic than their pristine counterparts. This may be due to either surface texture changes or oxidation functionality surface changes. Despite long-term exposure (fluence of 5.16 × 10^{20} atoms/cm^2), the water contact angles remained relatively unchanged after the initial exposure. This implies that increasing the atomic oxygen fluence after an initial short exposure did not further affect the hydrophilicity of the polymers. Rather, polymers were affected by a very short exposure (<1 × 10^{19} atoms/cm^2). This indicates that oxidation functionality is more likely the contributor to increased hydrophilicity than texture, as texture continues to develop with fluence. The water contact angles of fluorinated polymers were found to change significantly less than non-fluorinated polymers for equivalent atomic oxygen exposures, and two of the fluorinated polymers became more hydrophobic.

Significant decreases in the post-exposure water contact angle were measured for non-fluorinated polymers. The majority of change in water contact angle was found to occur with very low fluence exposures, indicating potential cell culturing and other biomedical benefits with very short treatment time.

This work was done by Kim de Groh of Glenn Research Center; Lauren Berger and Lily Roberts of Hathaway Brown School; and Bruce Further information is contained in a TSP (see page 1). *Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18386-1.*

Crashworthy Seats Would Afford Superior Protection

Adjustments enable optimization of support for different body sizes and shapes.

Lyndon B. Johnson Space Center, Houston, Texas

Seats to prevent or limit crash injuries to astronauts aboard the crew vehicle of the Orion spacecraft are undergoing development. The design of these seats incorporates and goes beyond crash-protection concepts embodied in prior spacecraft and racing-car seats to afford superior protection against impacts. Although the seats are designed to support astronauts in a recumbent, quasi-fetal posture that would likely not be suitable for non-spacecraft applications, parts of the design could be adapted to military and some civilian aircraft seats and to racing-car seats to increase levels of protection.

The main problem in designing any crashworthy seat is to provide full support of the occupant against anticipated crash and emergency-landing loads so as to safely limit motion, along any axis, of any part of the occupant's body relative to (1) any other part of the occupant's body, (2) the spacecraft or other vehicle, and (3) the seat itself. In the original Orion spacecraft application and in other applications that could easily be envisioned, the problem is complicated by severe limits on space available for the seat, a requirement to enable rapid egress by the occupant after a crash, and a requirement to provide for fitting of the seat to a wide range of sizes and shapes of a human body covered by a crash suit, space suit, or other protective garment. The problem is further complicated by other Orion-application-specific requirements that must be omitted here for the sake of brevity.

To accommodate the wide range of crewmember body lengths within the limits on available space in the original Orion application, the design provides for taller crewmembers to pull their legs back closer toward their chests, while shorter crewmembers can allow their legs to stretch out further. The range of hip-support seat adjustments needed to effect this accommodation, as derived from NASA's Human Systems Integration Standard, was found to define a parabolic path along which the knees must be positioned. For a given occupant, the specific position along the path depends on the distance from the heel to the back of the knee.

The application of the concept of parabolic adjustment of the hip-support structure caused the seat pan to also take on a parabolic shape, yielding the unanticipated additional benefit that the seat pan fits the occupant's buttocks and thighs more nearly conformally than do seat pans of prior design. This more nearly conformal fit effectively eliminates a void between the occupant's body and the seat pan, thereby helping to prevent what, in prior seat designs, was shifting of the occupant's body into that void during an impact.

The seat includes a thigh-support structure and a lower-leg support structure that can be adjusted for various heel-to-back-of-knee lengths. The occupant's heels are supported by a heel support pan and could be affixed to the pan by clips similar to those of mountain biking shoes and pedals or by straps over the tops of the feet. At the pivot between the thigh and lower-leg support structures there is a flat panel that provides for strength in adjustment and provides lateral support of the knees. The combination of lateral support of the knees and support and restraint the of the feet is intended to prevent flailing or other movement of the legs while the occupant is seated.

The seat includes lateral supports at the hips that serve the dual purpose of restraining the occupant from shifting laterally and providing structural support to the rest of the seat by acting as a gusset. To accommodate all hip sizes, the seat pan is designed to fit the largest hip breadth allowable. For a smaller occupant, spacer pads can be installed to fill the voids. Shoulder supports, which cover the shoulder joints and extend short distances down the arms, are also sized for occupants having shoulders of maximum breadth and to be fitted to smaller occupants by use of spacer pads. The seat supports bony protrusions of the torso at the shoulders and hips only, leaving the mid-torso area free of supports to enable the occupant to leave the seat by rolling though the clear space.

The seat includes a head support. However, head support on the prototype differs from the envisioned Orion head support: In Orion, the occupant would wear a space helmet and the head support would extend along the right and left sides of the helmet to prevent lateral motion of the head.

Another prominent design feature is a load-distributing seven-point harness similar to harnesses worn in off-road automobile racing. The seven-point harness includes straps over the tops of the shoulders that act, in effect, as wrap-around extensions of the lateral shoulder supports.

This work was done by Dustin Gohmert of Johnson Space Center. Further information is contained in a TSP (see page 1). ***.*** *MSC-24485-1*

Open-Access, Low-Magnetic-Field MRI System for Lung Research

Lyndon B. Johnson Space Center, Houston, Texas

An open-access magnetic resonance imaging (MRI) system is being developed for use in research on orientational/gravitational effects on lung physiology and function. The open-access geometry enables study of human subjects in diverse orientations. This system operates at a magnetic flux density, considerably smaller than the flux densities of typical other MRI systems, that can be generated by resistive electromagnet coils (instead of the more-expensive superconducting coils of the other systems).

The human subject inhales air containing ^{3}He or ^{129}Xe atoms, the nuclear spins of which have been polarized by use of a laser beam to obtain a magnetic resonance that enables high-resolution gas space imaging at the low applied magnetic field. The system includes a bi-planar, constant-current, four-coil electromagnet assembly and associated electronic circuitry to apply a static magnetic field of 6.5 mT throughout the lung volume; planar coils and associated circuitry to apply a pulsed magnetic-field-gradient for each spatial dimension; a single, detachable radio-frequency coil and associated circuitry for inducing and detecting MRI signals; a table for supporting a horizontal subject; and electromagnetic shielding surrounding the electromagnet coils.

This work was done by Ross W. Mair, Matthew S. Rosen, Leo L. Tsai, and Ronald L. Walsworth of the Harvard-Smithsonian Center for Astrophysics; Mirko I. Hrovat of Mirtech, Inc.; Samuel Patz of Brigham and Women's Hospital; and Iullian C. Ruset and F. William Hersman of the University of New Hampshire for Johnson Space Center.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

Harvard-Smithsonian Center for Astrophysics
Cambridge, MA 02138

Refer to MSC-24182-1/3-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

Microfluidic Mixing Technology for a Universal Health Sensor

John H. Glenn Research Center, Cleveland, Ohio

A highly efficient means of microfluidic mixing has been created for use with the rHEALTH sensor — an elliptical mixer and passive curvilinear mixing patterns. The rHEALTH sensor provides rapid, handheld, complete blood count, cell differential counts, electrolyte measurements, and other lab tests based on a reusable, flow-based microfluidic platform.

These geometries allow for cleaning in a reusable manner, and also allow for complete mixing of fluid streams. The microfluidic mixing is performed by flowing two streams of fluid into an elliptical or curvilinear design that allows the combination of the flows into one channel. The mixing is accomplished by either chaotic advection around microfluidic loops.

All components of the microfluidic chip are flow-through, meaning that cleaning solution can be introduced into the chip to flush out cells, plasma proteins, and dye. Tests were performed on multiple chip geometries to show that cleaning is efficient in any flow-through design. The conclusion from these experiments is that the chip can indeed be flushed out with microliter volumes of solution and biological samples are cleaned readily from the chip with minimal effort.

The technology can be applied in real-time health monitoring at patient's bedside or in a doctor's office, and real-