ture of the present version of the process is the use of centrifugation to ensure complete permeation of the template by the hot agarose solution.

To satisfy the requirement for sustained or timed release of nerve-growth agents, it has been proposed to incorporate, into scaffolds, reservoirs containing such agents. In cases in which the agent is BDNF, the proposal encompasses an alternative approach in which the reservoirs would be filled with genetically engineered cells that secrete BDNF. The figure illustrates the proposal as it might be implemented in a scaffold that would be attached to the severed ends of a peripheral nerve. Attached to the scaffold would be open-ended sleeves that would enable attachment to the severed nerve ends. The pores in the scaffold would serve as channels to guide the growth of the nerve ends toward each other. The reservoir containing the nerve-growth agent would be integrated into the outer wall of the scaffold. The nerve-growth agent would be delivered from the reservoir to the channels by diffusion through the agarose hydrogel matrix.

This work was done by Jeffrey Sakamoto of Caltech and Mark Tuszynski of UC San Diego for NASA's Jet Propulsion Laboratory.

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:

Innovative Technology Assets Management
JPL
Mail Stop 202-233
4800 Oak Grove Drive
Pasadena, CA 91109-8099
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Refer to NPO-45303, volume and number of this NASA Tech Briefs *issue, and the page number.*

Chemically Assisted Photocatalytic Oxidation System

Lyndon B. Johnson Space Center, Houston, Texas

The chemically assisted photocatalytic oxidation system (CAPOS) has been proposed for destroying microorganisms and organic chemicals that may be suspended in the air or present on surfaces of an air-handling system that ventilates an indoor environment. The CAPOS would comprise an upstream and a downstream stage that would implement a tandem combination of two partly redundant treatments. In the upstream stage, the air stream and, optionally, surfaces of the air-handling system would be treated with ozone, which would be generated from oxygen in the air by means of an electrical discharge or ultraviolet light. In the second stage, the air laden with ozone and oxidation products from the first stage would be made to flow in contact with a silica-titania photocatalyst exposed to ultraviolet light in the presence of water vapor. Hydroxyl radicals generated by the photocatalytic action would react with both carbon-containing chemicals and microorganisms to eventually produce water and carbon dioxide, and ozone from the first stage would be photocatalytically degraded to O_2. The net products of the two-stage treatment would be H_2O, CO_2, and O_2.

This work was done by Jean Andino, Chang-Yu Wu, David Mazyck, and Arthur A. Teixeira of the University of Florida for Johnson Space Center. Further information is contained in a TSP (see page 1).

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:

University of Florida
Environmental Engineering
Weil Hall
Gainesville, FL 32611

Refer to MSC-23828-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

Use of Atomic Oxygen for Increased Water Contact Angles of Various Polymers for Biomedical Applications

Improved polymer hydrophilicity is beneficial for cell culturing and implant growth.

John H. Glenn Research Center, Cleveland, Ohio

The purpose of this study was to determine the effect of atomic oxygen (AO) exposure on the hydrophilicity of nine different polymers for biomedical applications. Atomic oxygen treatment can alter the chemistry and morphology of polymer surfaces, which may increase the adhesion and spreading of cells on Petri dishes and enhance implant growth. Therefore, nine different polymers were exposed to atomic oxygen and water-contact angle, or hydrophilicity, was measured after exposure. To determine whether hydrophilicity remains static after initial atomic oxygen exposure, or changes with higher fluence exposures, the contact angles between the polymer and water droplet placed on the polymer's surface were measured versus AO fluence. The polymers were exposed to atomic oxygen in a 100-W, 13.56-MHz radio frequency (RF) plasma asher, and the treatment was found to significantly alter the hydrophilicity of non-fluorinated polymers.

Pristine samples were compared with samples that had been exposed to AO at various fluence levels. Minimum and maximum fluences for the ashing trials were set based on the effective AO erosion of a Kapton witness coupon in the asher. The time intervals for ashing were determined by finding the logarithmic values of the minimum and maximum fluences. The difference of these two values was divided by the desired number of intervals (ideally 10). The initial desired fluence was then multiplied by this result (2.37), as was each subsequent desired fluence. The flux in the asher was determined to be approximately 3.0×10^{15} atoms/cm^2 sec, and each polymer was exposed to a maximum fluence of 5.16×10^{20} atoms/cm^2.

It was determined that after the shortest atomic oxygen exposure (fluence of 2.07×10^{18} atoms/cm^2), non-

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 $\times$ 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 $\times$ 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.