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CONFERENCE TITLE: Electro-active Polymer Actuators and Devices (EAPAD) (ss04)
CONFERENCE CHAIR: Yoseph Bar-Cohen, Jet Propulsion Lab.
ABSTRACT TITLE: Electroactive polymer (EAP) actuators for planetary applications

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ABSTRACT TEXT: NASA is seeking to reduce the mass, size, consumed power, and cost of the instrumentation used in its future missions. An important element of many instruments and devices is the actuation mechanism and electroactive polymers offer an effective alternative to current actuators. In this study, two families of electroactive polymer (EAP) materials were investigated, including bending ionomers and longitudinal electrostatically driven elastomers. These materials were demonstrated to effectively actuate manipulation devices and their performance is being enhanced in this on-going study. The recent observations are reported in this paper, which also include cryovac tests at conditions that simulate Mars environment. Tests at T=-140°C and P~1 Torr, which are below Mars conditions, showed that the bending actuator was still responding with a measurable actuation displacement. Analysis of the electrical characteristics of the ionomer showed that it is a current driven material rather than voltage driven. Measurements of transient currents in response to a voltage step shows a time constant on the order of few seconds with a response speed that is enhanced with the decrease in drive voltage. The ionomer main limitation is its requirement for being continuously moist. Tests showed that while the performance degrades as the material becomes dry, its AC impedance increases, reaching an order of magnitude higher than the wet ionomer. This response provides a gauging indication of the material wetness status. Methods of forming the equivalent of a skin to protect the moisture content of the ionomer are being sought and a limited success was observed using thick platinum electroding as well as when using polymeric coating.

KEY WORDS: Miniature Robotics, Electroactive Polymers, Hand Simulation, Electroactive Actuators, EAP Materials

BRIEF BIOGRAPHY: Dr. Yoseph Bar-Cohen is a physicist with over 27 years experience in NDE, sensors, actuators and electroactive materials. He is the Jet Propulsion Lab (JPL) Resident NDE expert and the Group Leader for the NDE& Advanced Actuators (NDEAA) Technologies. Also, he is an Adjunct Professor at the Department of the Mechanical and Aerospace Engineering, the University of California, Los Angeles (UCLA), a Fellow of the American Society for NDT (ASNT) and Chair of the ASNT's Ultrasonic Committee. Dr. Bar-Cohen discovered the leaky Lamb waves and the polar backscattering in composite materials and co-pioneered their applications to NDE. He is the author of more than 135 publications, made numerous presentations at national and international symposia and holds many patents.