PIEZOCERAMIC MICROACTUATION FOR ROBOTIC SPACE EXPLORATION

SARITA THAKOOR, J. M. MOROOKIAN, J. 'PAl<SAl/A, M. A. NEWELL,
11.11. WILCOX and A. J. GANINO
Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109

ABSTRACT

The Jet Propulsion Laboratory (JPL) is developing a miniaturized prototype robotic vehicle (a nanorover), with a mass of only a few hundred grams. Such a nanorover is intended for in-situ exploration of the planetary surfaces such as Mars, gathering science data on rock mineralogy and geology, An important science instrument included as the payload of the nanorover is a near infrared point spectrometer. High precision microactuators are required to provide the desired fine focus adjustment for the slits of the spectrometer, primarily to compensate for the temperature validations in the optical path- length of the spectrometer (with an overall length of -10 cm), Piezoceramic microactuators, particularly the Reduced and Internally Biased Oxide Wafer (RA1NI1OW) is selected as a baseline candidate to control accurate positioning of the slit over a displacement range of --100 microns (with an application of a control voltage of 150 V or less) and a high precision position holding (within +/- 5 microns) for the fine focus control. in fact, the breakthrough in size reduction of actuators offered by piezoceramics due to the high torque, high energy density, good cyclability, and potential for wide temperature range of operation make piezoactuators a leading candidate for a variety of space applications that require micromobility and precision microactuation. Following a brief overview of the microactuation research anti development efforts at JPL, this paper will present our recent results on the resonance characteristics of the selected piezoceramic candidate for the micropositioning application. Cyclability of the RAINBOW ceramic at low temperatures (Mars ambient ~ 150K) and its suitability for the desired actuation range will also be discussed.