With this baseline established, future efforts will examine a large number of eutectic mixtures of these various ILs. In particular, the dicyanamide-based ILs appear to offer high performance potential, while preserving the large liquidus range so desirable for propellants. Importantly, the dicyanamide ILs did not contain any oxidizing atoms (oxygen, chlorine, fluorine), which should further enhance operational safety.

One common complaint regarding IL propellants is their high viscosity. Scientists' ability to accurately predict, *a priori*, any fluid property of a binary IL — much less a eutectic mixture of two binary ILs — is still in its infancy. However, a trend that has been seen is that large structural differences between the cation and anion seem to improve fluid properties. Therefore, one goal for future efforts will be to experiment with different IL cores and mixtures to maximize Isp performance and density, while simultaneously reducing liquid viscosity and glass transition point.

This work was done by Syri Koelfgen of Dryden Flight Research Center; Joe Sims, Melissa Forton, and Barry Allan of Analytical Services, Inc.; and Robin Rogers and Julia Shamshina of the University of Alabama. Further information is contained in a TSP (see page 1). DRC-010-041

Variable Emittance Electrochromics Using Ionic Electrolytes and Low Solar Absorptance Coatings

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One of the last remaining technical hurdles with variable emittance devices or skins based on conducting polymer electrochromics is the high solar absorptance of their top surfaces. This high solar absorptance causes overheating of the skin when facing the Sun in space. Existing technologies such as mechanical louvers or loop heat pipes are virtually inapplicable to micro (< 20 kg) and nano (< 5 kg) spacecraft.

Novel coatings lower the solar absorption to Alpha(s) of between 0.30 and 0.46. Coupled with the emittance properties of the variable emittance skins, this lowers the surface temperature of the skins facing the Sun to between 30 and 60 °C, which is much lower than previous results of 100 °C, and is well within acceptable satellite operations ranges. The performance of this technology is better than that of current new technologies such as microelectromechanical systems (MEMS), electrostatics, and electrophoretics, especially in applications involving micro and nano spacecraft.

The coatings are deposited inside a high vacuum, layering multiple coatings onto the top surfaces of variable emittance skins. They are completely transparent in the entire relevant infrared region (about 2 to 45 microns), but highly reflective in the visible-NIR (near infrared) region of relevance to solar absorptance.

This work was done by Prasanna Chandrasekhar of Ashwin-Ushas Corporation, Inc. for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15601-1