

NASA SBIR/STTR Technologies

08-2 X4.01-9712 - High Performing, Low Temperature Operating, Long Lifetime Aerospace Lubricants

PI: Bryan V. Bergeron
Physical Sciences Inc. – Andover, MA



Identification and Significance of Innovation

- Long-duration, planetary space exploration and spacecraft subsystems operations require lubricants that can perform effectively over several years with minimal or no maintenance.
- PSI's innovation: Evaluated liquid formulations comprising novel ionic liquid (IL) additives in perfluoropolyalkylether base lubricants. Unique IL chemical structures enhanced their dispersion in base fluids, reduced friction, and increased load carrying capability, with no additional corrosive effects, volatility, or chemical instability relative to base lubricants.

Expected TRL Range at the end of Contract (1-9): 3

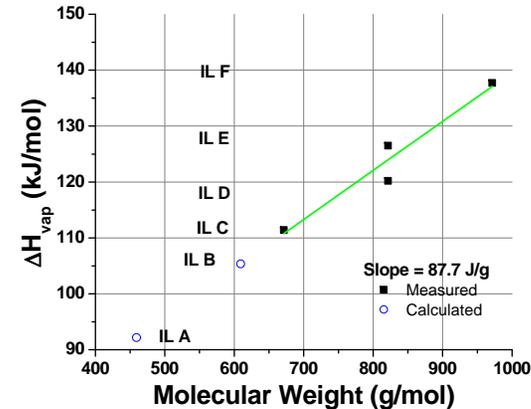
Technical Objectives and Work Plan

Specific objectives:

- Synthesize/characterize 12 new (>98% purity) ionic liquid additives
- Show vapor pressures $< 10^{-7}$ torr at 25°C, and stability up to 250°C
- Demonstrate no additional corrosion effects, 20% viscosity decrease from -70°C to +60°C, and lower COF/wear effects of formulations
- Scale 4 ILs to 25 g each
- Show lower coefficient of friction (COF), wear, and volatility of a new formulations relative to a standard lubricant in a NASA test bed

Specific tasks:

- Synthesize/characterize 12 new ionic liquid additives
- Measure vapor pressures and thermal stabilities
- Record corrosion effects on steel
- Measure temperature dependent viscosities
- Measure friction coefficients and wear effects
- Perform scale-up
- Evaluate IL formulations in NASA test bed



Heat of vaporization of
several ionic liquids
vs. molecular weight

NASA and Non-NASA Applications

- Ionic liquid lubricant additives will have direct applications to NASA aerospace systems that require minimal/no maintenance over extended periods of time. These systems include rovers and machinery used in constructing the lunar habitat.
- Ionic liquid lubricant additives will substantially increase performance, and reduce maintenance costs and frequencies of industrial transportation, terrestrial machinery, and construction systems. The compounds will also be valuable in gyroscope bearings on board satellites, or NASA, military, and commercial spacecraft.

Firm Contacts

Dr. Bryan V. Bergeron, Physical Sciences Inc.,
20 New England Business Center, Andover, MA 01810;
Phone: 978-689-0003; Fax: 978-689-3232; E-mail:
bergeron@psicorp.com

NON-PROPRIETARY DATA