

2009 JPL SURP Strategic Topic Areas

Topic Area:	6. Enabling Robotic Missions to Scientifically-Interesting Extreme Environments
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NASA's 2006 Solar System Exploration Roadmap* recommended a set of robotic exploration missions for the next 30 years, in small, medium and large mission classes. These proposed missions are expected to target planets, moons and small bodies in the Solar System, while encountering diverse extreme environmental conditions through their mission phases. These extreme environments (EE) include high and low temperatures and pressures, corrosive atmospheres, and high radiation environments at various planetary destinations. EE conditions are often coupled, for example, high temperatures and pressures near the surface of Venus. Extreme environments due to mission operations are also affected: for example, thermal heating during planetary entry. While some of the technologies for EE mitigation are currently available, a development of numerous new technologies is required to enable missions and thus NASA's solar system exploration plans.

Examples of technologies and capabilities of special interest are given below:

- Robotic systems that can survive and operate close to or directly on the Venus surface (~485 C and 90 bar) for extended periods of time (month):
 - Design and analysis of the novel active cooling system capable of pumping on the order of 100W of heat from the lander/rover to the Venus environment. A total systems approach is of interest as opposed to the development of a particular component.
 - Novel, light weight thermal control technologies including thermal energy storage systems with 300 - 1000 kJ/kg energy density through either phase changes or chemical heat absorption
 - Mechanisms for robotic operations and the acquisition of samples on the surface of Venus including drills, robotic arms, wheels, etc.
 - Sensors (instruments) capable of operation in 485C and 92 bar temperature and pressure environments.
 - Small, light-weight science packages able to acquire samples, operate and communicate data in Venus environment.
- Robotic systems that can survive and operate in low temperature (-180 C) and vacuum/or low pressure environments, for extended periods of time (years) without requiring the thermal control:
 - Novel ideas for low temperature power generation and storage.
 - Low temperature, long life mechanisms.
 - Integrated sensors and instruments, capable of operation at low temperatures.
 - Low power, low temperature electronics for instruments/sensors and control of motors and actuators.

*For detailed description of NASA's future missions plans and scientific goals: "Solar System Exploration Roadmap" can be downloaded from: <http://www.lpi.usra.edu/opag/>