Thermoelectric Power Conversion for Solar System Exploration

J.-P. Fleurial, B. Nesmith, J. Mondt, T. Caillat, G.J. Snyder and R. Surampudi
Jet Propulsion Laboratory/California Institute of Technology
MS 277-207, 4800 Oak Grove Drive, Pasadena, California 91109-8099, U.S.A.

Thermoelectric power sources have consistently demonstrated extraordinary reliability and longevity for deep space missions (26 U.S. missions to date, up to 30 years/mission). This is a truly outstanding track record. Key advantages of this technology include no moving parts, high intrinsic redundancy, excellent scalability, no electromagnetic interference or vibrations, and a well documented graceful degradation over extended periods of time.
In the last ten years, intense research on novel thermoelectric materials and structures has resulted in significant performance improvements. The development of advanced modular thermoelectric converters, based on novel segmented or cascaded unicouple or multicouple configurations is projected to lead to 2 X increase in power system conversion efficiency and specific power. Initial system engineering studies predict increases from 6.5 to 13-15% efficiency and from 4.7 to 8-11 W/kg for a 100-300W radioisotope power system; from 4 to over 8% efficiency and from 46 down to 28-32 kg/kW for a 100kW fission power system.
Thermoelectrics are currently one of 3 conversion technologies being considered by the Jupiter Icy Moons Orbiter 2011 mission, and one of 2 technologies being pursued for radioisotope-powered Mars missions. Opportunities and technical challenges for use of advanced thermoelectrics in solar system exploration are presented and discussed.

Technical Topic Category: **B4 Results of Power Generation Devices and Systems**
Presentation preference: **Oral**

Presenting author: **Dr J.-P. Fleurial**
Contact author**: Dr J.-P. Fleurial**
Jet Propulsion Laboratory
MS 277-207
4800 Oak Grove Drive
Pasadena, California 91109-8099
U.S.A.
Phone: **1 / 818-354-4144**
Fax: **1 / 818-393-6951**
E-mail: **jean-pierre.fleurial@jpl.nasa.gov**