RADIONUCLIDE PRODUCTION FOR RADIOISOTOPE MICRO-POWER SOURCE TECHNOLOGIES

David E. Meier

Dr. J. David Robertson, Dissertation Supervisor

ABSTRACT

Radioisotope micro-power sources (RIMS) hold great promise for the development of miniaturized power sources for use in numerous applications, including micro-electromechanical systems (MEMS), due to the five orders of magnitude difference in the specific energy density available in radioactive decay versus chemical reactions. While a number of conversion schemes can be employed in RIMS, betavoltaic technologies are compatible with the semiconductor manufacturing processes used in MEMS. A solid-state betavoltaic device consists of a p-n semiconductor coupled with a beta-emitting radionuclide. Liquid semiconductor betavoltaic devices were investigated simultaneously with the solid-state designs as an alternative concept designed to minimize radiation induced lattice damage that occurs in solid-state devices formed through interaction with high-energy charged particles. Radioisotopes used for the fabrication of solid-state semiconductor sources include ^{33}P and ^{147}Pm. Sulfur-35 was selected as the isotope for liquid semiconductor tests because it can be produced in high specific activity and it is chemically compatible with the liquid semiconductor media under investigation. The irradiation, separation and subsequent chemistries of curie amounts of activity were performed at the University of Missouri Research Reactor (MURR) for ^{35}S and ^{147}Pm.