Scandium Tritide for MicroPower Source Applications

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The progress of Nano/MicroElectroMechanical Systems (N/MEMS) demands compatible micropower sources. Metal tritides, which have conventionally been used for tritium storage, have the potential of addressing this demand owing to its high power density, long life time, and readily integrable on-chip in thin film form. In this study we examine the structural and energy emission properties of scandium tritide and explore its application for electrical and optical generation.

Scandium tritide (ScT_x) is prepared by exposing thin films of thermally evaporated scandium to tritium gas at elevated temperature of 350 ^oC. Thermal effusion measurement show that the majority of tritium effuses at ~600 ^oC. The outgassing rate at room temperature is negligible with an estimated effusion half-life of >100 years. Surface activity of ScT_x is 15-25 mCi/cm^2, corresponding to a beta flux of 90-150 pA/cm^2. The power density of the ScT_x foil has a range of 0.5- 1.3 $\mu W/cm^2$, which is suitable for the development of micropower sources. The tritium to scandium ratio of the films, *x*, is unity.

We propose three potential applications for scandium tritide beta sources. One, tritium directly occluded in a contact potential difference betavoltaic battery, where the ScT_x film serves as an electrode and an energetic source of electrons; two, ScT_x providing the motive force for a constantly vibrating micro-cantilever piezoelectric energy harvester; and, three, an array of ScT_x pixels for betaluminescence. We present experimental data on the performance of betavoltaic and betaluminescent devices, and model calculations of the tritium-micro-cantilever energy harvester.