Development of High Temperature Superconductors for Wind Energy

Venkat Selvamanickam
University of Houston, Houston, TX 77204

Abstract: There is a world-wide interest in the development of innovative, efficient and environmentally-benign technologies for energy generation, conversion, transmission, storage. High Temperature Superconductor (HTS) wires provide benefits of resistanceless transmission of electricity, ultra-high power densities, and rapid response to power surges in the electric grid. The feasibility of offshore wind turbines, operating at 10 MW and higher, improves because of the reduction in size and weight by 50% when using HTS generators. The challenge has been in developing the brittle ceramic HTS materials in lengths of over a kilometer with properties similar to that of high quality epitaxial thin films. Novel materials processing has been developed to fabricate superconducting wires as thin films on flexible metal substrates with excellent critical current performance by manipulation of grain orientations and nanoscale defects. HTS wires are now being manufactured in quantities of few hundred kilometers annually with current carrying capacity of about 300 times that of copper wire of the same cross section. In the past few of years, tremendous advancements have occurred in nanoscale defect engineering in these thin film superconducting tapes wires has led to a quadrupling of critical current performance in high magnetic fields. An overview of recent advances in the development of high temperature superconductors for wind energy applications will be provided in this presentation.

Biographical Sketch

Venkat Selvamanickam is a M.D. Anderson Chair Professor of Mechanical Engineering at the University of Houston, the Director of the Texas Center for Superconductivity Applied Research Hub and the Founder of the industry-led consortium – Advanced Superconductor Manufacturing Institute. Previously, he was the Chief Technology Officer of SuperPower Inc, a former subsidiary of Philips Electronics. He led SuperPower to multiple world-records for the highest performance thin film high temperature superconductor (HTS) wire over several length scales, the longest 2G HTS wire made and first to pilot manufacturing. He led the world's first significant delivery of thin film superconductor wire to build a power transmission cable in Albany, NY, which is the world's first demonstration of a thin film superconductor device in the power grid.

At the University of Houston, Dr. Selvamanickam led the recently-completed, highly successful ARPA-E-funded program to achieve four-fold improvement in in-field performance of superconductor wires. Prof. Selvamanickam has published over 230 papers and holds 80 issued patents. He is the recipient of the Presidential Early Career Award for Scientists and Engineers (PECASE) from the White House, which is the highest award given to scientists and engineers beginning their independent careers. He has also received three R&D 100 awards, the Superconductor Industry Person of the Year award, Wire and Cable Technology International Award and the IEEE Dr. James Wong Award for Continuing and Significant Contributions to Applied Superconductivity Materials Technology. In 2014, Prof. Selvamanickam was elected to be inducted into the U.S. National Academy of Inventors.