



33rd TcSUH STUDENT/POSTDOC SEMINAR

Tuesday, March 18, 2025 - 4:30 pm, HSC 102

Meet & Greet: Food and soft drinks will be served at 4:15 p.m.!!

Development of REBCO Thin Films Using MOCVD on Non-Standard Buffers Substrates

Manoj Thevalappilly

Department of Material Science and Engineering

Abstract: Rare Earth Barium Copper Oxide (REBCO) superconducting thin films on dielectric substrates are being developed for microwave and radio frequency applications such as transmission lines for quantum computing. Our group previously demonstrated the growth of REBCO thin films on short, flexible, yttria-stabilized-zirconia (YSZ) substrates. In this study, we report high-quality REBCO films on 12-cm-long flexible YSZ substrates. We planarized the surface of 40- μm -thick flexible YSZ substrate by vertical dip coating in n-propanol solution to achieve average surface roughness $R_a < 1$ nm over 12 cm. We deposited a biaxially textured magnesium oxide (MgO) template on a yttria seed layer using Ion Beam Assisted Deposition (IBAD) on flexible YSZ. Then, we deposited a 120-nm-thick MgO layer and a 120-nm-thick LaMnO_3 (LMO) cap layer. The out-of-plane and in-plane texture values of the LMO films were 3.9° and 6.9° respectively. REBCO films of a thickness of 350 nm were grown on these 12-cm-long flexible YSZ substrates by metal organic chemical vapor deposition (MOCVD) and a critical current density (J_c) of 1.06 MA/cm^2 was achieved at 77 K, 0 T. We are also developing an electrically conductive buffer architecture for defect-tolerant REBCO tapes, to shunt current from the REBCO film to substrate. This buffer architecture is based on conductive titanium nitride buffer on Hastelloy C276 substrate, with an oxide cap layer deposited by magnetron sputtering. REBCO films, about 350 nm thick, have been grown by MOCVD on this buffer architecture with a J_c greater than 1 MA/cm^2 at 77 K, self-field. Texture, microstructure, composition and critical current density of REBCO tapes on electrically conductive buffers will be presented.

Bio: Mr. Manoj Thevalappilly Paulose is a PhD candidate in the Department of Materials Science and Engineering working under the supervision of Dr. Venkat Selvamanickam. His research focuses on developing high-temperature superconducting (HTS) coatings on flexible dielectric substrates and engineering REBCO coatings over conductive buffer layers using metal-organic chemical vapor deposition (MOCVD). These advancements are crucial for enabling next-generation superconducting tapes with enhanced mechanical flexibility and electrical performance, making them suitable for applications in power transmission, compact fusion reactors, and high-field magnet technologies.

Charge transfer engineering in Ge Te materials to achieve extraordinary thermoelectric power

Dr. Ying Peng

Department of Physics and Texas Center for Superconductivity

Abstract: The multicenter interaction involving metavalent bonding, or hyperbonding, represents a promising approach for optimizing the physical properties of materials, including their thermoelectric (TE) and mechanical properties. Here, we demonstrate that fine-tuning the Ge-Te bonds through charge transfer engineering can yield exceptional TE and mechanical properties in GeTe. This approach enables control over the band structure, including band sharpening and convergence, and generates a semi-ordered zig-zag nanostructure that enhances the power factor and reduces thermal conductivity. As a result, we achieve a striking average zT value of ~ 1.73 in the 323 to 773 K temperature range, with a maximum zT of ~ 2.7 . Furthermore, we significantly enhance the microhardness to an extraordinary high value of 247 Hv, and the charge transfer engineering effectively eliminates the thermal expansion fluctuation at the phase transition that can be problematic for practical applications. We also fabricate a single-leg TE generator and demonstrate a conversion efficiency of $\sim 13.4\%$ at a temperature difference of 463 K on a commercial instrument, achieving high thermoelectric conversion performance.

Bio: Dr. Ying Peng is a post-doctoral fellow in Department of Physics and Texas Center for Superconductivity at University of Houston working in Dr. Ren's group. He obtained his PhD in 2020 at Nagoya University in Japan. Additionally, he worked as a Professor at the Guilin University of electronic technology. He is particularly interested in semiconductor materials. Some of his research focused on thermoelectric material, in which he worked on understanding how to improve the power factor of semiconductor materials and inhibit thermal conductivity by composite control technology, to obtain high ZT and thermoelectric devices with high waste heat utilization efficiency were further prepared.