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Nathan Newman

Arizona State University, USA

In-situ characterization of performing degrading defects in superconductor- dielectric microwave resonators

The physical nature and concentration of paramagnetic point defects in the dielectrics of superconducting planar microwave resonators have been determined using in-situ electron paramagnetic resonance spectroscopy. To perform this work, the quality factor of parallel plate and stripline resonators was measured as a function of the magnitude of a magnetic-field applied parallel to the electrode surfaces. YBa2Cu3O7-d thin film electrodes proved to be a preferred choice over Nb and MgB2 because they are readily available and have a small surface resistance (Rs) up to high temperatures (~77 K) and magnetic fields (i.e., <1 T). Stripline resonators with a widely used high performance microwave dielectric, Co2+ doped Ba(Zn1/3Nb2/3)O3, are shown to have losses dominated by d-electron spin-excitations in exchange-coupled Co2+ point-defect clusters, even in the absence of an applied magnetic field. A significant enhanced microwave loss in stripline and parallel plate resonators is found to correlate with the presence of paramagnetic Mn dopants in Ba(Zn1/3Ta2/3)O3 ceramics and dangling bond states in amorphous Si thin films, although the identification of the dominant loss mechanism(s) in these dielectrics requires further investigation.

Biography

Nathan Newman is a Professor of Solid State Sciences and is a faculty member in the Materials Program at Arizona State University. His research interests focus on the investigation of novel solid-state materials for microwave, photonic and high-speed applications. His current work involves synthesis, characterization and modeling of novel superconductor junctions and materials, III-N semiconductors, low loss dielectrics for microwave communication, and novel photovoltaic material. He is an author and co-author of over 200 technical papers, has 12 patents, has an h-index over 40 and his papers have been cited over 5,000 times. He has received the IEEE Van Duzer Award, is a Fellow of the IEEE and the American Physical Society, and has won Faculty Teaching Awards at Northwestern University and Arizona State University. He also serves as an Associate Editor for Materials in the *IEEE Transactions of Applied Superconductivity* and has served as the Chair of the US Committee on Superconductor Electronics and ASU's LeRoy Eyring Center for Solid State Sciences.

Nathan.Newman@asu.edu