Complex perovskites such as $\text{Ba(}\text{Zn}_{1/3}\text{Ta}_{2/3}\text{)}\text{O}_3$ (BZT) are used as commercial microwave dielectric materials in cell phone base stations. These materials are required to exhibit low dielectric loss and high quality factors ($Q$). Commercial materials use transition metal (i.e. $\text{Ni}^{2+}$, $\text{Co}^{2+}$, $\text{Mn}^{2+}$) additives to enhance the sintering process and adjust the microwave performance. There is strong interest in reducing the operating temperature to improve the performance of the dielectric, as is found for sapphire, $\text{MgO}$ and $\text{LaAlO}_3$. However, at cryogenic temperatures, these transition metals introduced into BZT and other commercial dielectrics are found to markedly enhance the dielectric loss. This mechanism has been shown by my group to arise from an electron paramagnetic resonance process (EPR). My work has focused on producing and characterizing high-performance microwave dielectrics that are undoped or contain non-paramagnetic additives.

Synthesis of BZT ceramic with over 98% theoretical density was obtained in undoped material and using $\text{B}_2\text{O}_3$ or $\text{BaZrO}_3$ additives. The use of $\text{ZrO}_2$ resulted in low density (95%), poor quality ceramics. We have characterized the microwave, structural and chemical properties of these samples. Addition of 5%$\text{BaZrO}_3$ to BZT, sintering at $1600{}^{\circ}\text{C}$ for 10 h in presence of air shows an increase in $Q$ with decreasing temperature. Temperature dependent Microwave properties were measured by using dielectric resonator technique (DR). At $4\text{K}$ temperature $Qf$ product of $\approx 280,000$. 