Ultra High Temperature Ceramic (UHTC) ZrB2-10, 20, 30wt%SiC composites are of high interest for hypersonic air-breathing vehicles. In this work ZrB2-10, 20, 30wt%SiC UHTC composites were produced by Spark Plasma Sintering (SPS) technique. After sintering, almost dense ceramics with ~5-8% porosity were produced. Their mechanical properties, such as Young’s, shear, and bulk moduli, along with Poisson’s ratio, 4-point bending strength, and SEVNB fracture toughness were measured. In addition, in-situ bending experiments under Raman microscope were performed to determine the piezo-spectroscopic coefficients of SiC Raman active peaks for calculation of thermal residual stresses. The results show that these materials are a possible candidate for hypersonic air-breathing vehicles with its high Young’s modulus, ability to withstand high temperatures, and a relatively low density.