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New LTCC- hexaferrites by using reaction bonded glass ceramics

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Innovative multilayer ceramics structures are of exceptional interest for new high frequency applications in the field of the communications and the automotive industry. For the next generation of high-integrated 3D-packaging and miniaturized modules in mm-wave devices, it will be necessary to combine standard LTCC-dielectrics with new magnetic ceramics for applications in phase shifters and circulators. Interesting magnetic material candidates for frequencies f > 1 GHz with a high permeability μ > 10 are the hexaferrites, especially $BaFe_{12}O_{19}$. Hexaferrites are usually prepared according to the standard mixed oxide method with high sintering temperatures of up to 1350°C which is not useful for LTCC technology.
In this work the sintering temperature of $BaFe_{12}O_{19}$ was reduced to 900°C by the development of reaction-bonded glass ceramics systems for LTCC-hexaferrites. Low amounts of reactive glasses (< 5 vol.%) based on boron and zinc oxide were used as sintering additive to achieve full densification at 900°C. The influence of variation in glass-ceramics compositions, different processing parameters, advanced powder preparation by using high energy milling and the calcinations temperature on achieving high-μ ferrites at 900°C was studied. The magnetic properties of these LTCC-hexaferrites were characterized by a coaxial airline method and impedance measurements in the frequency range of 0.1 to 10 GHz. The influence of phase composition and microstructure on magnetic properties was also discussed.