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Microwave response of coaxial cavities made of bulk MgB_2

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We report on the microwave (mw) properties of coaxial cavities built by using bulk MgB_2 superconductor.

The bulk MgB_2 specimens have been produced by Reactive Liquid Mg Infiltration process [1]. Three different coaxial cavities have been prepared by using bulk MgB_2. In particular, two of them are composed by an outer copper cylinder and an inner MgB_2 rod; two inner rods of lengths 45 mm and 94 mm have been used. The third cavity is constituted by the MgB_2 rod of 45 mm and an outer MgB_2 cylinder about 15 mm longer than the inner rod. Figure 1 shows a picture of the outer MgB_2 cylinder.

The resonant cavities have been characterized measuring their frequency response in the range 1 – 13 GHz by an hp-8719D Network Analyzer, in the temperature range 4.2 – 50 K. The cavities built using the 45 mm rod exhibit four resonant modes, in the range 2.5 - 11 GHz; the spectrum of the cavity with the 94 mm MgB_2 rod shows eight resonant modes in the range 1.3 -11 GHz.

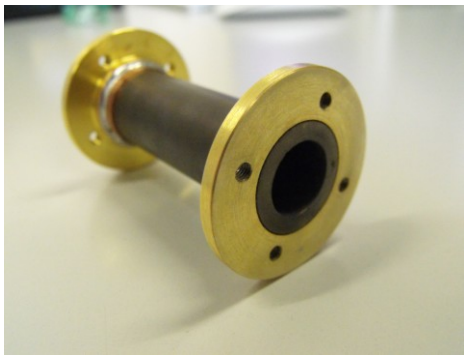

Figure 1: Bulk MgB_2 cylinder used for assembling the coaxial cavity

Preliminary results have shown that, at T = 4.2 K, the highest unloaded quality factor of the cavity entirely made of MgB_2 is $Q \approx 80000$ at the resonant frequency f = 2.55 GHz. It remains of the order of 10^4 up to about 30 K and reduces by a factor of 60 when the superconductor goes into the normal state.

The results obtained in the coaxial cavity entirely made of MgB_2 will be compared with those already obtained in a MgB_2 cylindrical cavity [2] and discussed with the aim to exploit the material in mw applications.

Recently, we have built a tunable coaxial cavity using a rod of BSCCO and have shown that it can be conveniently used to investigate the mw response of the inner superconducting rod, in both linear and nonlinear regimes [3]. We will use the longer cavity with this aim. In particular, it will be possible to determine the frequency dependence of the mw surface resistance of the MgB_2 in the frequency range 1 - 11 GHz; to our knowledge, this issue is not widely discussed in the literature.

[1] G. Giunchi, G. Ripamonti, T. Cavallin, E. Bassani, Cryogenics **46** (2006) 237.

[2] G. Giunchi, A. Agliolo Gallitto, G. Bonsignore, M. Bonura, M. Li Vigni, Supercond. Sci. Technol. **20** (2007) L16.

[3] A. Agliolo Gallitto, G. Bonsignore, M. Li Vigni, A. Maccarone, , Supercond. Sci. Technol. **24** (2011) 095008 (8pp).