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Magnetoelastic Effects in DyNiBC and TbNiBC Studied by High Resolution Synchrotron X-ray Scattering

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Abstract – We have performed synchrotron experiments on polycrystals of DyNiBC and TbNiBC. Low temperature measurements indicate a possible tetragonal-to-monoclinic distortion below ~17.5K for DyNiBC. A similar behavior has been observed for TbNiBC below ~ 15K, however the structural distortion for this compound seems to be different from that observed in DyNiBC.

The quaternary intermetallic compounds RNi_2B_2C (R=rare earth) are well known due their intrinsic physical properties, among which we can mention the coexistence of superconductivity and long range magnetic order of the rare earth magnetic moments [1]. Furthermore, the superconductor $ErNiB_2C_2$ (T_c=10.5K) and non-superconductor $TbNi_2B_2C$, with basal plane spin wave ordering, experience a tetragonal-to-orthorhombic distortion below 6.3 K and 14.3 K respectively [2,3]. Adding one more R-C layer between two adjacent Ni_2B_2 blocks in RNi_2B_2C results the magnetic non superconductors RNiBC family with tetragonal structure [4]. Neutron diffraction studies had shown that HoNiBC orders antiferromagnetically below 9.8K and ErNiBC becomes ferromagnetic at 4.6K. On the other hand, TbNiBC and DyNiBC exhibit more complicated magnetic structures. TbNiBC orders ferromagnetically at T_C=15 K and below 12.5 K an incommensurate modulation develops as well as an antiferromagnetic component. The moments, which vary in magnitude and direction, are in the *a*-*b* plane. DyNiBC exhibits the same behavior, with a T_C = 17.5K and T_N = 13.5 K [4]. With such a complex magnetic structures one would also expect to find a magnetostrictive behavior for TbNiBC and DyNiBC, similar to observed in RNi_2B_2C series.

High resolution x-ray diffraction measurements as a function of temperature were performed at the D10B-XPD beamline of the LNLS on polycrystals of TbNiBC and DyNiBC. As the DyNiBC is cooled below ~17.5 K the (111) Bragg peak first broadens and then splits. A preliminary analysis of the lowest temperature x-ray spectrum indicates a possible tetragonal-to-monoclinic distortion below T_C for this compound. The mismatch between the *a* and *b* lattice parameters appears with the onset of long-range ferromagnetic order. For TbNiBC the situation is quite different, in this compound is the (101) Bragg peak that split below ~15K. The results show a clear magnetoelastic distortion occurring in DyNiBC and TbNiBC below ~17.5 K and ~15 K, respectively. Furthermore, the type of structural transition occurring in DyNiBC is different of that of TbNiBC.

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