Torsion-induced magneto-impedance in nanocrystalline *Fe*-based wires

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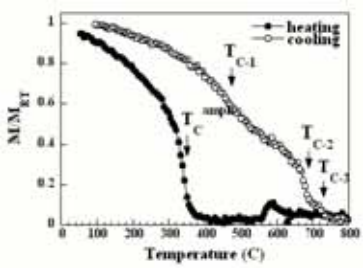
Two amorphous $Fe_{73.5}Si_{13.5}B_9Cu_1Nb_3$ wires with diameter of 98mm have been annealed at 560°C in zero magnetic field during 20 min, one without torsion (an) and the other with a constant torsion angle of $\pi/20$ rad/cm in the clock-wise sense (t-an).
The components of the *Surface Impedance Tensor* have been measured at 1 MHz and 5 mA_{rms} drive current in all the samples.



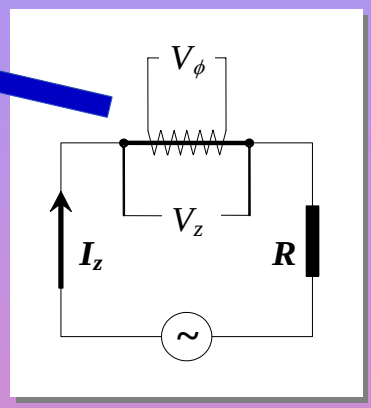
The Curie temperature for the amorphous phase is ~350 °C. On cooling down from high temperature, the M(T) curve suggests the existence of three different Curie temperatures, T_{C-1}, T_{C-2} and T_{C-3}, that can be ascribed to a Fe-B phase (probably $Fe_{23}B_6$), Fe-Si (with around 20 at.% Si) and Fe_2B respectively.

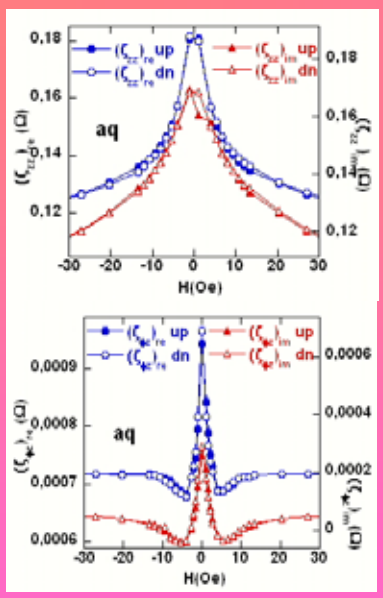
Surface Impedance Tensor

Axial component: $\zeta_{zz} = (V_z/I_z)\ (2\pi a/L)$

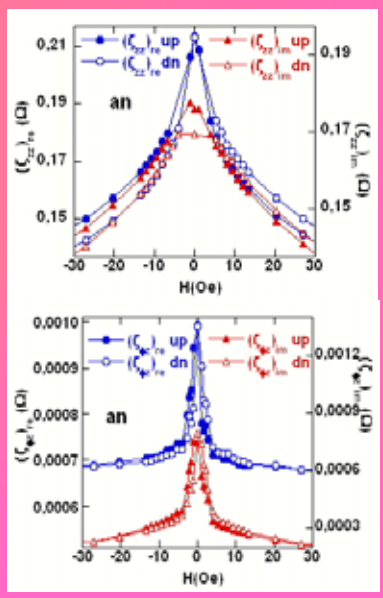
Off-Diagonal Component: $\zeta_{\phi z} = (V_\phi/I_z)\ (1/N)$

	λ_s	H_c(Oe)	ρ_{dc}(μΩ·cm)
aq	17.6×10^{-6}	0.44	220
an	4.5×10^{-6}	0.23	174
t-an	0.8×10^{-6}	0.06	174

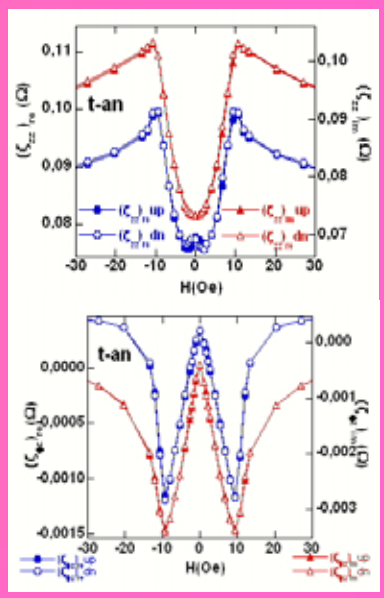




Both the real and imaginary parts in the ζ_{zz} and $\zeta_{\phi z}$ components exhibit a single peak, which can be ascribed to an axial anisotropy.



The MI effect has increased in the nanocrystalized sample. There is a hysteretic behavior at the low field range, where the domain wall displacements have prevalence.



ζ_{zz} shows a double peak behaviour. Two local maxima at H~±2 Oe corresponding to the coercitive field are also showed.
The induced helical anisotropy is reflected in both parts of the off-diagonal component

Conclusions

The application of a torsional stress during the annealing leads to a double-peak behaviour in both axial-diagonal and off-diagonal components of the surface MI tensor at 1 MHz.

For the untwisted wire the MI response has the single-peak behaviour at the same drive frequency.

References

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