# Magnetism and Ferromagnetic Loss in Ni-W and Ni-Cr Textured Substrates for Coated Conductors

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Second generation coated conductors are based almost exclusively on the high-Tc superconductor $YBa_2Cu_3O_{7-\delta}$, which must be highly textured to conduct high density electrical currents. One route to achieve this necessary grain orientation is to deposit the HTSC on a buffered, highly textured metal substrate, prepared by "RABiTS" (Rolling Assisted Biaxially Textured Substrates) methods. At present, the metals of choice are Ni and its fcc alloys with chromium or tungsten. However, these materials are generally ferromagnetic (FM), and the question naturally arises as to what effect this may have on the coated conductor. An area of special interest is the loss sustained when conducting an ac current, since the associated ac fields tend to drive both the superconductor and the FM substrate irreversibly, which dissipates energy and causes heating.

To address this and related issues, we have studied the magnetic properties of a series of biaxially textured $Ni_{1-x}Cr_x$ and $Ni_{1-x}W_x$ materials with compositions $x = 0 – 13$ at.% Cr and 0 – 9 at.% W. The quasi-static dc and ac hysteretic loss $W$ was determined to support estimates of the ferromagnetic contribution to the overall ac loss in potential ac applications. The alloys were prepared by either vacuum casting or powder metallurgy methods, and the hysteretic loss tended to be lower in materials that were recrystallized at higher temperatures. Some samples were progressively deformed (0.4 % bending strain) to simulate winding operations; this increased the hysteretic loss, as did sample cutting operations that create localized damage. In ac magnetization measurements, the effects of ac frequency and DC bias field on the ferromagnetic loss were determined. Finally, we show that the observed ac transport losses in pre-commercial coated conductors on Ni-W substrates can be understood as a sum of hysteretic losses: one contribution from the superconductor (dominant at currents near the critical current) and a second contribution from the FM substrate (fractionally larger at lower currents).