became prominent this time too with reduced value of column capacitors. A study of voltage buildup pattern along the height of the multiplier stack revealed that seventh onward decks do not require voltage ratings more than 60 kV for the entire operating range of the accelerator. So a mix of 90 kV and 60 kV (3 capacitors and 2 capacitors in series) decks were assembled in a ratio of 7: 5 and finally a multiplication ratio of 9.5 was obtained with 12 such decks. Before reaching the target voltage in the high voltage generator, individual decks were tested for their rated voltages of 90 kV and 60 kV respectively.

The multiplier stack has been compensated and operated at 33 kHz for a terminal voltage of 760 kV for minimum no-load current from inverter. The 1st stage voltage in this condition was measured to be 80 kV DC. This shows that with a voltage multiplication ratio of 9.5 and permitted 1st stage voltage of 90 kV we can achieve a no load terminal voltage of 855 kV in the high voltage generator with SF_6 as an insulating medium. Furthermore the calculated voltage drop in the multiplier stack at 33 kHz is about 4 kV/ mA. This indicates that operation of the H V generator at full rated current of 25 mA will result a DC voltage drop of 100 kV and accelerating terminal voltage of 755 kV. Hence the rated power of the H V generator will be achieved. Also the load induced ripple at 25 mA comes out to 2 kVpp, which is well within the specified limit of 2%.

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A.2 : Large magneto-resistance in the Heusler alloy $Ni_{50}Mn_{34}In_{16}$.

The Heusler alloys are now well known as potential source of functional magnetic materials. They have a cubic $L2_1$ structure in the high temperature (T) austenite phase, and a general formula X_2YZ (with X = Cu, Ni, Pd, Y = Mn, Co, and Z = Al, In, Sn, Sb, etc.). They exhibit interesting physical phenomena of technological interest like ferromagnetic shape memory effect (FSME), large magneto-resistance (MR), and giant magnetocaloric effect. We, the MSMS of RRCAT, have been studying the Heusler alloys for quite some time for their functional properties. We have now established that the 'disorder influenced first order magnetostructural transitions' plays a crucial role in the phenomena mentioned above.

$Ni_{50}Mn_{34}In_{16}$, with the stoichiometry deliberately chosen as such, is a Heusler alloy of our current interest. The high T austenite phase of the material is paramagnetic (PM). With the lowering of T, it undergoes a PM to ferromagnetic (FM) transition at around 305K, and remains FM down to the lowest measured T (5K). But as T is lowered below 250K, the alloy also undergoes an austenite to martensite phase transition (i.e., martensitic transformation) .

As shown in Fig.A.2.1, the electrical resistivity (ρ) vs. T data exhibits a sharp jump around 250K and has a thermal hysteresis associated with this jump. The jump in ρ(T) is because of change in the crystal structure associated with the martensitic transformation. The thermal hysteresis suggests the first order nature of the transition. Away from this hysteretic region the temperature coefficient of ρ is positive, highlighting the metallic character of both martensite and austenite phases. The application of magnetic field has two effects: First, to decrease the value of ρ in both the phases. Second, to shift the characteristic temperatures of the martensitic transformation towards lower T. This second effect leads to a very large MR around the martensitic transformation. MR has been calculated using following standard definition:

$$MR\ (\%) = \frac{\rho(H) - \rho(0)}{\rho(0)} \times 100$$

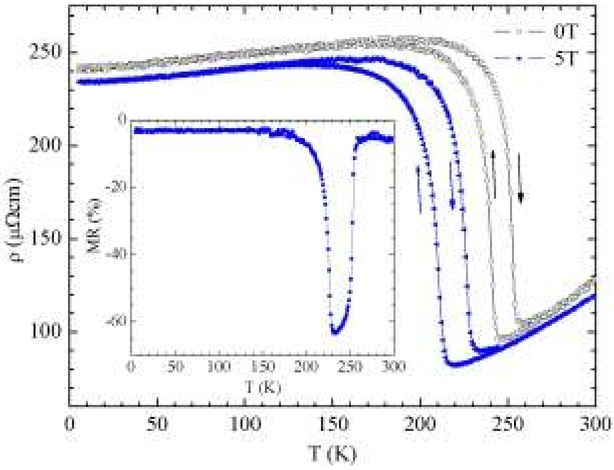

Fig.A.2.1 Temperature dependence of resistivity of $Ni_{50}Mn_{34}In_{16}$ alloy in 0 T and 5T magnetic fields. The arrows indicate changing temperature. Inset shows the corresponding magneto-resistance.

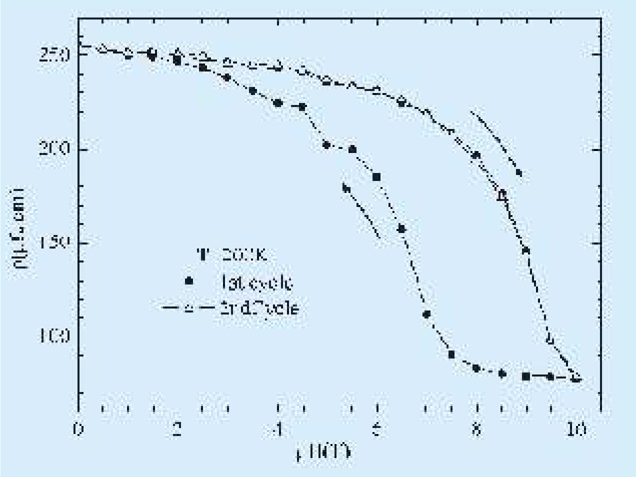

Fig.A.2.2 Isothermal field dependence of resistivity of $Ni_{50}Mn_{34}In_{16}$ at 200K. The arrows indicate direction of field change.

The inset to Fig. A.2.1 shows MR as a function of T for $Ni_{50}Mn_{34}In_{16}$ in magnetic field of 5T. An MR of 64% is obtained in 5T magnetic field at 230K. Even for a moderate magnetic field of 1T, an MR as large as 46% is obtained. On increasing the magnetic field to 10T, the MR may be enhanced to 75%. It has been observed that the martensite to austenite phase transition can be induced by magnetic field as well. This is shown in Fig.A.2.2. The field induced transition is also hysteretic, highlighting the first order nature of the transition. But if the martensite to austenite transition is induced by magnetic field at temperatures above 230K, the alloy does not return to the martensite phase on reducing the field back to zero. It remains arrested in the austenite phase withstanding any number of subsequent field cycling. The alloy returns to the martensite phase completely only when it is cooled to 100K or lower [see for details, *V. K. Sharma et. al; Appl. Phys. Lett. 89, 222509 (2006)*]. Thus apart from the very large MR, $Ni_{50}Mn_{34}In_{16}$ also has interesting memory effects that make it important as a potential ferromagnetic shape memory alloy. We are therefore continuing further studies on the different characteristics of $Ni_{50}Mn_{34}In_{16}$ and their dependence on the thermal annealing treatments.

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A.3 : Testing of high T_c superconducting current leads

High T_c superconducting (HTS) current leads are finding increasing scope in powering of Superconducting (SC) devices on account of their high electrical conductivity and low thermal conductivity at temperature easily achievable using liquid nitrogen.

Regional Research Laboratory, Trivandrum (RRL-T) has taken up a DAE-BRNS project with RRCAT as principal collaborator for the development of general-purpose HTS current leads for direct application in high current SC magnet systems. The HTS leads were made using Pb doped Bi-Sr-Ca-Cu-O (Bi-2223) tapes sheathed with Ag-Au-Cu alloy housed inside stainless steel tubes. The testing of these HTS current leads has been done with joint efforts of Magnetic & Superconducting Materials Section, and Superconducting Technology Lab of AAMD, RRCAT, using the cryogenic test facility available at the Superconducting Technology Lab. The tests conducted were measurement of self-field critical current I_C and Voltage (V) – Current (I) characteristics at 77 K, operational stability at ~77 K and field trial with a SC magnet.

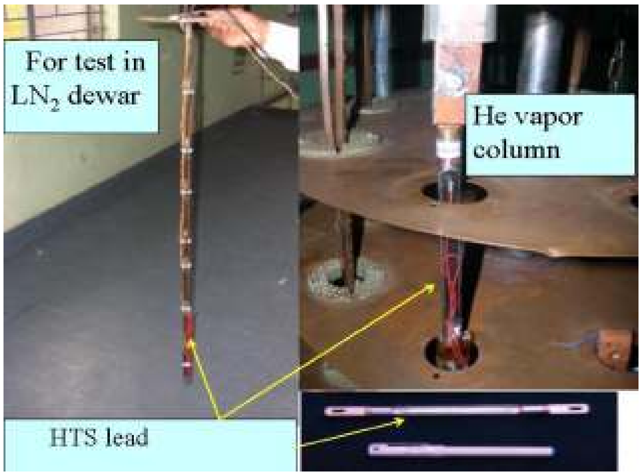

Fig.A.3.1 : HTS current leads and their testing configurations.

RRL-T had sent five current leads each 10 cm long, rated for 100A, 200A & 500A at 77K, designated as 100/1,100/2, 200/1, 200/2 and 500/1 .The testing of the leads at liquid nitrogen temperature was conducted in a standard liquid nitrogen dewar by using a special insert. The evaluation of operational stability of these leads at