A.4 Data acquisition system for contact resistance measurement of superconducting corrector magnets

For the contact resistance (CR) measurement the magnet under test is charged with rated current. It is then taken to the persistence mode using a Superconducting -switch connected in parallel. The decay of the Hall voltage (placed inside the magnet), which is proportional to the current, is monitored, to calculate the CR of magnet. A micro-controller based online Data Acquisition System has been developed and GUI is made using Lab VIEW (fig. A.4.1). The system is based on digitally controlled analog 8-1 multiplexer. The Micro-controller is programmed to switch the multiplexer sequentially to acquire data from eight channels with required time. User configurable method of data acquisition system provides the user an option to select number of channels and the data is displayed and stored. The signal is directly acquired from the 6-½-digit multimeter using GPIB communication. Switching signal is generated from PC and communicated through RS-232 to Micro controller, which generate the switching through multiplexer. The user-friendly GUI display panel is designed which gives the direct display of CR.

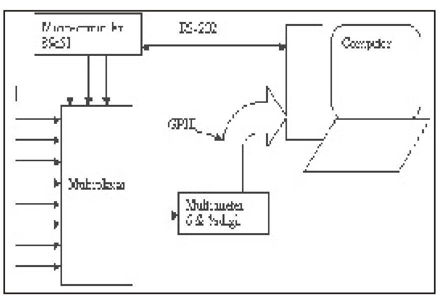

Fig. A.4.1 *DAS for contact resistance measurement*

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A.5 Ferromagnetic shape memory alloys

Shape Memory Alloys (SMA) have gained considerable attention due to their technological importance as smart materials. The key factor for the shape memory effect is a diffusionless structural phase transition called martensitic transformation (MT), which occurs between a high temperature Austenite phase and a low temperature Martensite phase. Ferromagnetic shape memory alloys (FSMA) are ferromagnetically ordered materials exhibiting reversible MT. FSMA are important for realization of shape memory actuators as they show large strain (~10% in 1 Tesla field) and faster response when exposed to an external magnetic field as compared to the conventional temperature and/or stress induced SMA.

Our main goal in FSMA is to study the nature of the martensitic and magnetic transitions, which are the key to the shape memory effect. These studies are also fundamentally important for understanding the first-order nature of the solid-solid phase transition in metallic alloys. Presently we are working on few systems of alloys, *viz*. Ni- Fe-Ga, Ni-Co-Al and Co-Ni-Ga. The alloys are prepared by melting the constituent elements in an inert argon atmosphere. We investigated these FSMA by resistivity and ac susceptibility measurements. Although we are working on few different alloys, here we shall highlight our accepted work on $Ni_{54}Fe_{19}Ga_{27}$ alloy only (S. Majumdar *et al.*, Solid State Commun. in press).

Ni-Fe-Ga alloys have been recently reported to show magnetic shape memory effect. The composition $Ni_{54}Fe_{19}Ga_{27}$ is chosen for our study, because both the magnetic and martensitic transitions occur within the accessible temperature (T) range of measurements. The ferromagnetic transition temperature (T_C) of the alloy is found to be 290 K. In ac susceptibility (fig. A.5.1) and resistivity measurements, the alloy shows an anomalous feature around 220 K, which is associated with thermal irreversibility. We identify the feature around 220 K due to MT, which can show thermal hysteresis due to the first order nature of the phase transition. On the contrary, the paramagnetic-ferromagnetic transition at 290 K does not show any thermal hysteresis, as it is a second order phase transition.

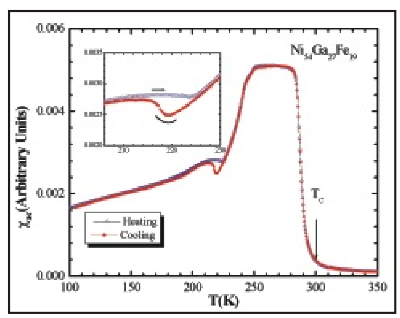

Fig. A.5.1 *Temperature dependence of ac susceptibility in $Ni_{54}Fe_{19}Ga_{27}$ sample*

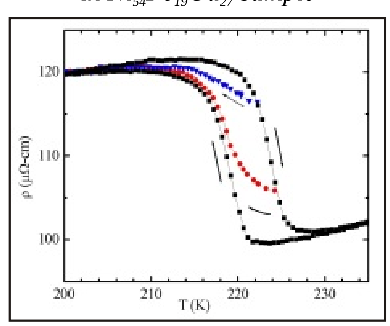

Fig. A.5.2 *Thermal hysteresis in the resistivity data of $Ni_{54}Fe_{19}Ga_{27}$ sample around the MT.*
The figure also depicts minor hysteresis loops.