The RF Stimulated Hall Potentials in High Temperature Superconductors $YBa_2Cu_3O_7$

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The Hall potentials had been recorded under radio-frequency (2-5.2 MHz range) perturbation which is found conventionally synthesized HTS Y_{123} at room temperature. The Hall coefficient R_H and electrical carrier density N_H had been computed and is found to be in the semiconductor range of the order of 10^{-14} and 10^{13} respectively.

Keywords: Hall Potential, Perturbation, High temperature superconductors (HTS), Hall coefficient.

1. INTRODUCTION

The electrical conductivity as well as magnetic conductivity in HTS ion conducting doped crystals, polycrystals, amorphous semiconductors, ion conducting polymers, ion conducting glasses is presently a field of major interenst [1,2]. In the present work, we have studied MRF stimulated conduction process in HTS Y_{123}. At low frequencies the electrical conduction is frequency independent, however at high frequencies, the ac conductivity seems to obey BNN power law [3]. The non-linear and chaotic oscillations in semiconductors and in these materials [4,5] under the influence of a transverse magnetic field called the dynamic Hall effect has been studied. The comprehensive account has also been given for the theoretical derivatives of non-linear dynamic magneto transports in HTS under radio-frequency stimulation [6,7,8].

2. SYNTHESIS AND PREPARATION

The synthesis of HTS $Y1_{23}$ was carried out following usual solid state reactions role with Y_2O_3 $BaCO_3$ and CuO as the starting materials. The stoichiometric powder mixture was thoroughly grounded for 1 hour subjected to calcinations in programmable furnace naberthenin (model No. C-19) for 12 hour in air at 850°C. Further calcinations comes out at 875˚C, 900˚C and 920˚C for 12 hours each with intermediate grindings.

Final concealed material was made in pallet form (5 Kbar) sweltered at 930˚C in flowing oxygen with the schedule (930˚C/24h/O_2) → (750˚C/2h/O_2) → (600˚C/24h/O_2) → (400˚C/24h/O_2) → furnace off and cool in O_2 (24h).

3. EXPERIMENTAL ANALYSIS

The HTS samples were employed in 4-probe Hall geometry and Hall potentials were recorded using VTVM as shown in Figure 1 at radio-frequency excitations between (2-5.2 MHz). The Hall coefficients R_H and electrical carrier density N_H had been computed and their frequency dependence have been shown Figure 2 and Figure 3 respectively.

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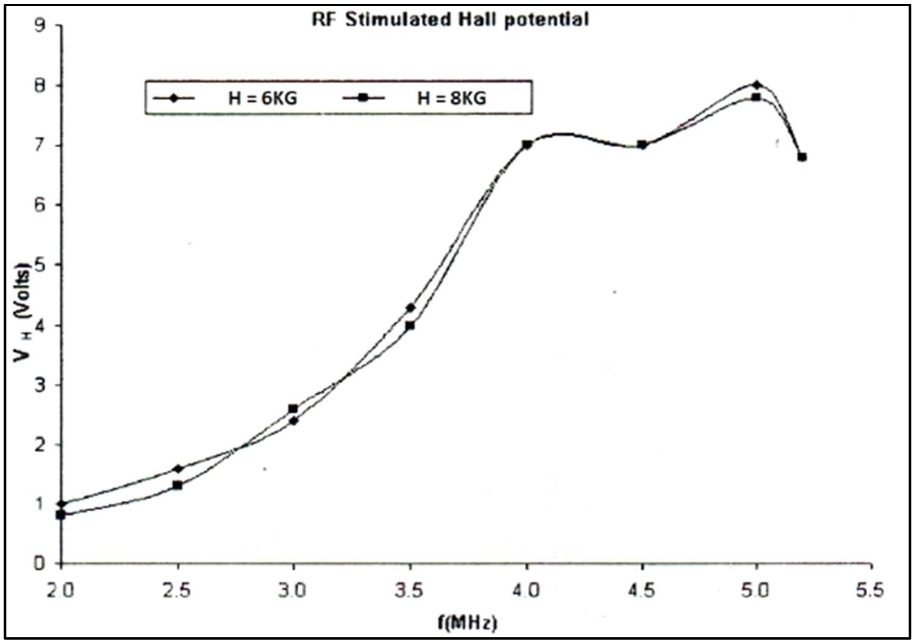

Fig. 1: The Hall potential behaviour at magnetic field H=6KG & 8KG.

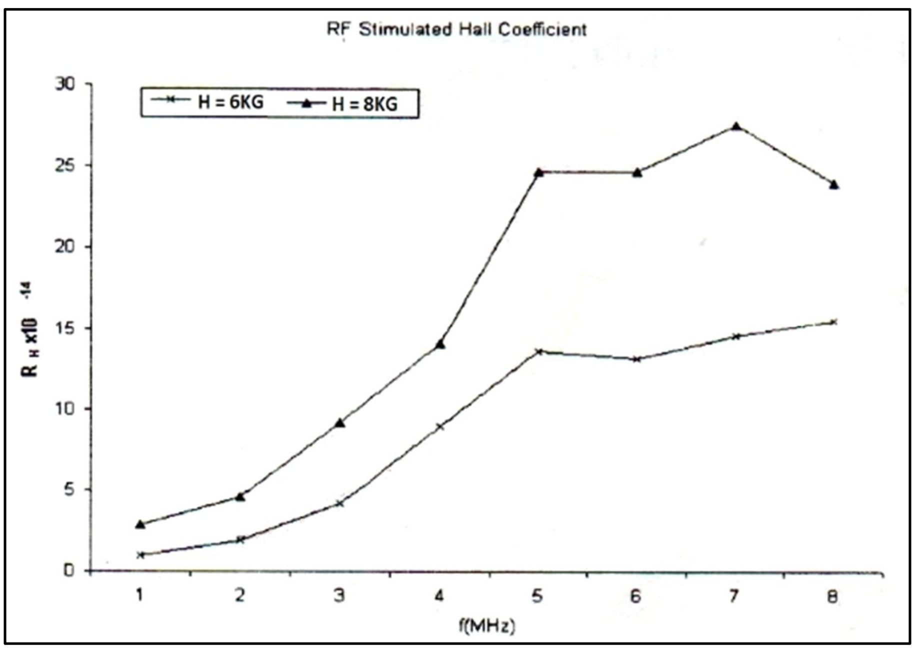

Fig. 2: The R_H factor behaviour at magnetic field H=6KG & 8KG.

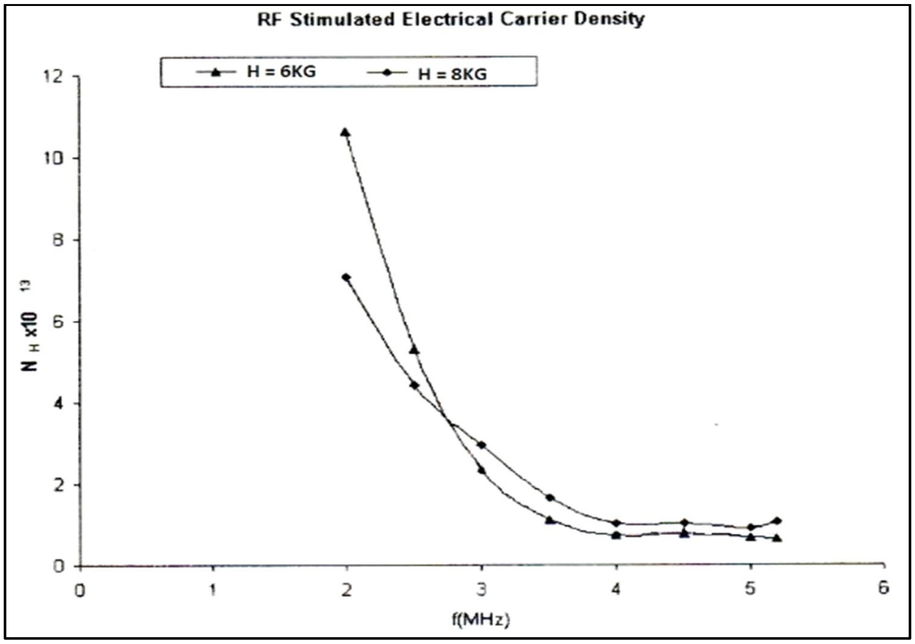

Fig. 3: The electrical carrier density N_H behavior with frequency at magnetic field H=6KG & 8KG.

4. RESULTS, DISCUSSION AND CONCLUSION

The Hall potential behaviours at magnetic field H=6KG & 8KG are shown in Figure 1 for HTS Y_{123} have an exponential rise upto frequency range 3.75 MHz having peak value 6 volts. The oscillation imposed upon FITS Y_{123} between frequency range (3.75-5.2 MHz) possesses two peaks having first order maxima at 4.2 MHz and the second order maxima at 5.1 MHz. It is worth noticeable that the Hall potential behaviour for HTS under MRF excitations are surprisingly large of the order of 10^3 with respect to metals.

The R_H factor at magnetic field H=6KG & 8KG with frequency is exponentially increasing from the residual values $1.41x10^{-14}$ & $2.82x10^{-14}$ respectively at 2 MHz as Shown in Figure 2. The maximum value are $11.3x10^{-14}$ & $27.53x10^{-14}$ at the frequencies 5 & 7MHz respectively.

The electrical career density being reciprocal to Hall coefficients seems to undergoes a sharp exponential decay from $10.63x10^{13}$ & $7.09x10^{13}$ maxima for the frequency 2 MHz and minima $0.64x10^{13}$ & $0.88x10^{13}$ at frequency 5.2 MHz respectively as shown in Figure 3. One may note further that the frequency change may influence the Zeeman splitting in case of RF-stimulated HTS Y_{123}. When the x-directional current is increased, the edge and bulk currents can not remain completely independent of each other. Experimentally the differential resistances are much larger beyond the breakdown due to the induced coupling of edge and bulk currents to be separated by magnetic field. The polytype heterostructures seems to possess the negative differential resistance with peak to valley current ratio large in HTS Y_{123} like other heterostructures GaSb/LISb/InAs. Thus, under an MRF applied external bias, a resonant interband tunneling of electrical carriers may be enhanced in HTS Y_{123}.

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