# Abstract

## Critical Behaviour of Thermal Relaxation in Composites

C. D. MUKHERJEE and K. K. BARDHAN[¶]

ECMP Division
Saha Institute of Nuclear Physics
1/AF Bidhannagar
Kolkata 700 064
India

bardhan@cmp.saha.ernet.in

**Received**: Fri, 15 Mar 2002 07:38:53

At a composition far above the percolation threshold, the resistance of a composite sample increases with time as a constant current is passed through the sample due to Joule heating. For a current less than the breakdown current, the resistance eventually reaches a steady value. The increase is found to be well described by a simple first-order exponential term with a characteristic relaxation time $\tau_h$. Similarly, when the sample is allowed to cool down from the steady state by reducing the constant current to a small value the resistance relaxation is again described by a first-order exponential with a relaxation time $\tau_c$ which is however different from $\tau_h$. Thus, relaxations during heating and cooling appear to possess different characteristic times. Both $\tau_h$ and $\tau_c$ exhibit critical behaviour as a function of the current $I$. Interestingly, it is found that the product $\tau_h \tau_c$ is a constant independent of $I$. $\tau_h$ diverges with $I$ as $\tau_h \sim (1 - I^2/{I_b}^2)^{-\alpha}$ where $I_b$ is the breakdown current and $\alpha$ is an exponent equal to 0.14. Consequently, $\tau_c$ goes to zero as $I$ approaches $I_b$. Attempts to understand this unusual phenomena will be discussed.

[¶]Presenter

**Filename**: Mukherjee-C-D
**Last document update**: Wed Jul 10 08:15:31 MDT 2002