Thermal Diffusivity Measurements of Some Industrially Important Alloys by a Laser Flash Method

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In present work, thermal diffusivity measurements of four different industrially significant alloys, *viz* CMSX-4 nickel base super alloy, 90Ti·6Al·4V, stainless steel with 24 % wt Cr and 6 % wt Ni, and plain carbon steel with 0.7 % wt carbon, have been carried out as a function of temperature. The aim of this work is to study the effect of temperature as well as microstructure on the thermal diffusivities of these alloys.

For the CMSX-4 alloy, below 1253 K, the experimental thermal diffusivity values were found to increase with increasing temperature. Microstructural investigations of quenched samples revealed the presence of two phases in the sample below 1253 K. Between 1253 K and solidus temperature, these intermediate phases start dissolving in the matrix alloy causing an increase in the impurity concentration of the alloy and thereby a small decrease in the thermal diffusivity values.

For the Ti alloy, thermal diffusivity increases at temperatures below 1225 K. Beyond this temperature, the values started decreasing, probably due to the dissolution of the Ti_3Al intermediate phase in the matrix, which would result in an increase in the disorder of the structure.

For 24Cr-6Ni stainless steel, the thermal diffusivity is nearly constant up to about 700 K. Beyond this, there is an increase in the thermal diffusivities with temperature during the heating cycle. On the other hand, the slope of the curve increases above 950 K. This phenomenon was similar even during the cooling cycle.

In the case of the 0.7 % carbon steel, the thermal diffusivity shows a decreasing trend with temperature below the Curie point for the alloy, where the alloy consists of both the bcc and fcc phase. Above this point, only the fcc phase is prevalent, and the thermal diffusivity was found to increase with temperature.

Heat transfer is carried out by lattice vibration (phonons) as well as electrons. The contribution of electrons varies depending on the type of alloy. In this study, the highest electron contribution was found in 0.7 % carbon steel, while the lowest was in stainless steel.