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Temperature distribution of read/write head soldering with ribbon cable of HDD☆

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ABSTRACT

In the present paper, the temperature distribution of the read/write head soldering with the ribbon cable of the HDD is presented. The soldering of the actuator/connector with the ribbon cable can be performed either by manual or semi-automatic process which has been introduced as one of the manufacturing processes of the HDD. Finite element analysis is applied to analyze the model. The properties of the soldering ball and boundary conditions have significant effects on the thermal stress and localized heat in the soldering process that cause the failure of the ribbon cable of the HDD. The results of this study are of technological importance for the efficient design and/or approval of the soldering HDD process to reduce yield loss of the hard disk drive.

1. Introduction

As hard disk drives become more advanced, all components of these devices are required to do more and work harder to obtain higher performance. Therefore, hard disk drive manufacturers are developing advanced manufacturing techniques in order to stay competitive and to reduce yield loss. The soldering of the actuator/connector with ribbon cable is one of the manufacturing processes of HDD. However, the localized heat and thermal stress of the ribbon cable are significant factors in the failure of the hard disk drive in the soldering process. Lim [1] analyzed the vibration of the hard disk drive spindle system by the finite element method. The proposed method can be applied for designing hard disk drives and various other high performance computer disk drives. Wu and Bogy [2] presented two multigrid numerical schemes to solve the slider air bearing problem of hard disk drives. Luk et al. [3] applied adhesive bonding techniques in hard disk drive head assembly. Liu et al. [4] studied the recording track density in hard disk drives. Effect of the butterfly mode was investigated using finite element analysis. Xu and Guo [5] experimentally studied the residual vibration of the head actuator assembly in hard disk drives. Yuan et al. [6] numerically studied the static pressure and surface shear forces on a rotating, umbrella-deformed disk in an open shroud. Two-dimensional numerical model of the axisymmetric deformation of disk was applied to determine the fluid force distributions along the radial direction of the rotating disk. Suriadi et al. [7] numerically investigated the airflow characteristic inside a 1 in hard disk drive. Two models with different actuator arm positions were considered. Yan et al. [8] presented the mathematical models of the spindle/disks–shaft–housing system for vibro-acoustic analysis of hard disk drives operating in idle mode.

As mentioned above, experimental and theoretical studies have been reported concerning the hard disk drive. However, only few papers reported on temperature distribution of the actuator of HDD. This paper focuses on the temperature distribution of read/write head soldering with ribbon cable of HDD. Localized heat and thermal stress in the read/write head soldering with ribbon cable has significant effect on the hard disk drive failure in the manufacturing process. Effects of the physical properties of the soldering balls and boundary heat transfer coefficient of the model on the temperature distribution are considered.

2. Mathematical modelling

All critical components of the head gimble assembly (HGA) structure are modeled as close to the actual design as shown in Fig. 1. The flexible printed circuit (Ribbon cable) flexible substrate structures consist of a polyimide base layer, copper trace with the polyimide layer and polyimide cover layer (adhesive layer is not considered). An actuator/connector and flexible printed circuit are bounded by curing the soldering balls. There are four spots and twenty spots to bind an actuator with flexible printed circuit and to bind the connector with flexible printed circuit, respectively as shown in Fig. 1. In the present analysis, the model is separated into two parts (actuator part and connector part) as shown in Fig. 2. In

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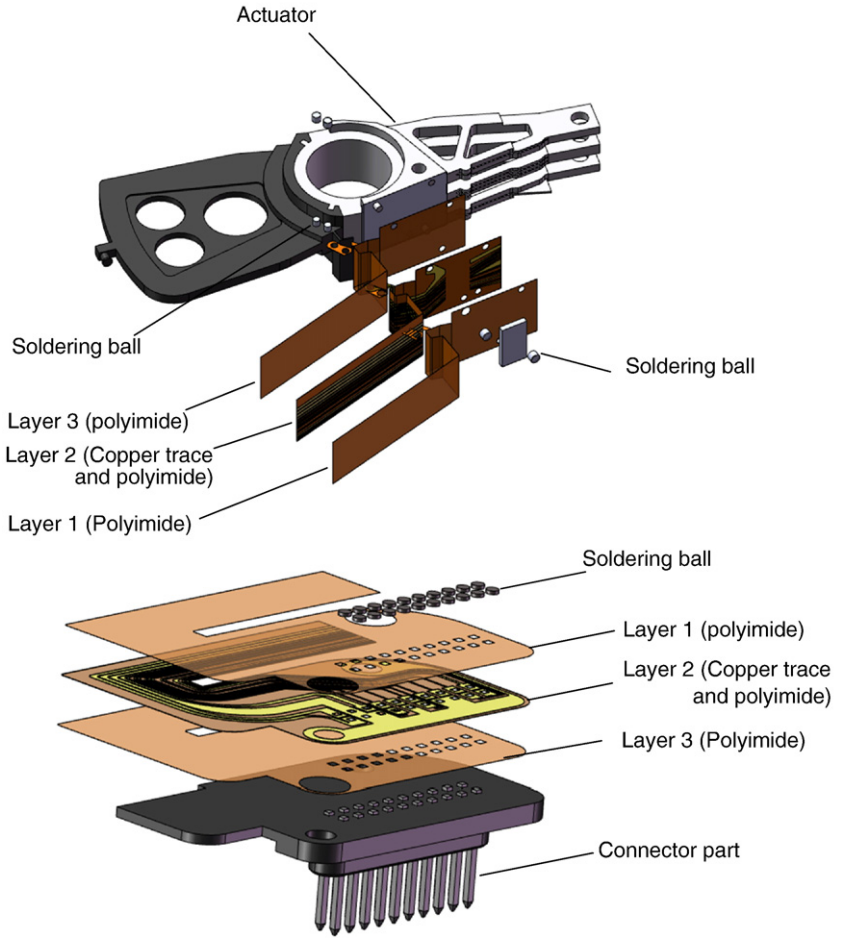

Fig. 1. Schematic diagram of the HDD head assembly.

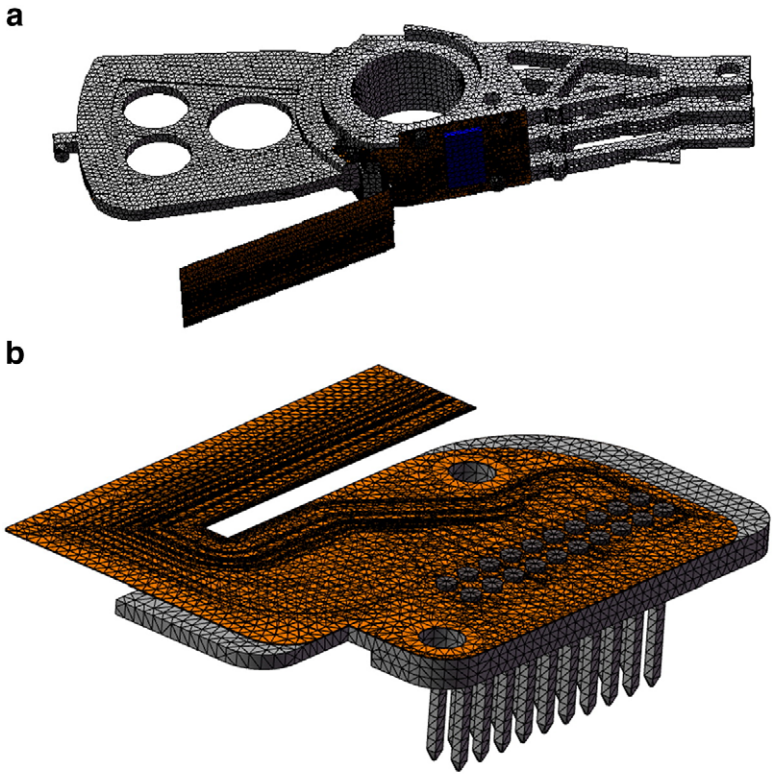

Fig. 2. Schematic diagram of the structured grid system of (a) an actuator part and (b) connector part.