## Description

The present invention is concerned with a thin film magnetic head employing nonmagnetic insulating material.

Thin film magnetic heads are well known and are described, for instance, in US -A- 4,219,854, US -A- 4,516,180 and US -A- 4,652,954.

The use of thermally activated crosslinking agents or promotors in connection with polymers is known. A photo resist composition using a very low percentage of a thermally activated crosslinking agent is disclosed in the IBM Technical Disclosure Bulletin, Vol. 14, No. 8, page 2309, January 1972. W. E. Feely, Proceedings of SPIE, Vol. 631, 48, 1986, shows crosslinking of a photo resist and subsequent heating.

US-A-4.115.366 discloses a molding compound of novolac resins having melamine added thereto for improving arc resistance, arc track voltage and flame retardance.

As far as we are aware, none of the prior art concerned with thin film magnetic head assemblies deals with the use of a photo resist containing a thermally activated crosslinking agent. For instance, none of the patents referred to above makes any mention of a thermally activated crosslinked photo resist. In like manner, the IBM Technical Disclosure Bulletin and the SPIE publication referred to above do not suggest the use of the compositions in thin film magnetic heads.

The invention seeks to provide an improved thin film magnetic head.

A thin film magnetic head having electrical insulation surrounding an electrically conductive core is characterised, according to the present invention, in that the insulation comprises a photosensitive resin which has been crosslinked by a thermally activated crosslinking agent or promotor. By the use of such materials for the insulation, the cure time is greatly reduced, the cure temperature is greatly reduced and there is produced a more stable insulation layer.

An additional advantage of the present invention is that the thermally activated crosslinking does not interfere with either the insulating properties of the final product or with the photolithography.

How the invention can be carried out will now be described by way of example, with reference to the accompanying diagrammatic drawing (Fig. 1) which represents a section of a thin film magnetic head assembly including an electrically conducting coil surrounded by an insulator.

With reference to the drawing, a thin film head assembly 11 comprises a nonmagnetic ceramic support on which are deposited magnetic pole piece layers 12 and 14. A nonmagnetic insulating material 22 is deposited between the pole piece layers 12 and 14. A transducing gap 16 interacts with a magnetic medium, preferably in an air bearing relationship, as is well known in the art. For this purpose, the support 10 is formed as a slider with an air bearing surface (ABS) that flies closely adjacent to the record medium, which may be a rotating magnetic disk, during operation of a disk file.

The thin film head structure has a back gap portion 18 formed by the closure of the pole pieces 12 and 14. The back gap closure 18 is spaced from the transducing gap, with a coil structure 20 interposed between the back gap and the transducing gap.

The continuous coil 20 is located between and coupled magnetically to the pole piece layers 12 and 14. The coil 20 and the pole pieces 12 and 14 are separated by the insulator 22, which encapsulates the portions of the coil between the pole pieces. The central area of the coil provides an electrical contact (now shown) and similarly, the outermost termination of the coil has an enlarged area for an electrical contact (not shown). The contacts are connected to external wiring and head circuitry (not shown) for processing write and read data signals.

A preferred resin for the insulation 22 is a novolac resin, many varieties of which are known. The novolac is made sensitive to radiation by the addition of a photosensitizer, many of which are known. Photo sensitizers include, for example, 1-oxo-2-diazonaphthalene sulfonic acid derivatives.

Three types of crosslinking promotors have been employed to thermally accelerate the crosslinking reaction for the insulation layers 22 in the thin film head. The first type involves the use of a melamine crosslinking agent. Such agents are commercially available, for example, the melamine resin Cymel 303, available from the American Cyanamid Company. Another type of thermally activated crosslinking agent available for use in the present invention is epoxy novolac resins in combination with a latent catalyst. Epoxy novolac resins include epoxy phenol (EPN) and epoxy cresol novolac (ECN) resins such as ECN 1273 from Ciba-Geigy. The latent catalyst is of the hindered boron trichloride family commonly used in the curing of epoxy compounds. These types of catalyst are commercially available, including DY9577 from Ciba-Geigy. Still a third type of crosslinking promotor is the bisazide type, for example 3.3'-diazido-diphenylsulfone, and 4,4'-diazido-diphenylsulfide. The thermally activated crosslinking promotor is preferably present in an amount from about 10 to about 50% by weight of the novolac resin, most preferably in an amount of 20 to 40% by weight.

The following examples are given solely to illustrate preferred embodiments of the present in-

vention, many variations of which will occur to those skilled in the art.

Different routes were employed to prepare thermally crosslinkable resists, depending on the type of crosslinking agent used. The first route made use of a melamine resin. To prepare an approximate 30 wt. % of melamine to novolac resin, 2g of hexamethoxymethylmelamine is added to 25g of a novolac based positive photo resist such as AZ1375 from Hoechst. With mixing, a homogeneous solution is attained. The thermally crosslinkable photo resist is ready for use.

The second type of resist contains ECN resin. To prepare a 20 wt. % mixture of resin to resist, 1.8g of epoxy cresol novolac is added to 25g of AZ1375 positive photo resist. The viscosity is reduced with the addition of 20 ml of cellosolve acetate solvent. Upon achieving a homogeneous mixture, 0.4g of DY9577 is added. After mixing for approximately one hour, the thermally crosslinkable insulation resist is ready for use.

A resist was prepared from AZ1350J novolac resin to which 10% by weight of 4,4'-diazidodiphenylsulfide was added with thorough mixing. The resist containing the additive became hardbaked much faster than the resist without the additive.

## Claims

1. A thin film magnetic head (11) having electrical insulation (22) surrounding an electrically conductive coil (20), characterised in that the insulation comprises a photosensitive resin which has been crosslinked by a thermally activated crosslinking agent or promotor.

2. A thin film magnetic head as claimed in claim 1, in which the photosensitive resin is a novolac resin.

3. A thin film magnetic head as claimed in claim 1 or claim 2, in which the crosslinking agent is a melamine.

4. A thin film magnetic head as claimed in claim 1 or claim 2, in which the crosslinking agent is an epoxy cresol novolac resin containing a latent catalyst.

5. A thin film magnetic head as claimed in claim 1 or claim 2, in which the crosslinking promotor is of the bisazide type.

6. A thin film magnetic head as claimed in any preceding claim, in which the thermally activated crosslinking agent or promotor comprises from 10 to 50% by weight of the resin.

7. A thin film magnetic head as claimed in claim 6, in which the thermally activated crosslinking agent or promotor comprises from 20 to 40% by weight of the resin.

## Patentansprüche

1. Ein Dünnfilm-Magnetkopf (11) mit einer elektrischen Isolierung (22), die eine elektrisch leitfähige Spule (20) umgibt, dadurch gekennzeichnet, daß die Isolierung ein photoempfindliches Harz umfaßt, welches durch ein thermisch aktiviertes Vernetzungsmittel oder einen Beschleuniger vernetzt wurde.

2. Ein Dünnfilm-Magnetkopf nach Anspruch 1, bei dem das photoempfindliche Harz ein Novolack-Harz ist.

3. Ein Dünnfilm-Magnetkopf nach Anspruch 1 oder Anspruch 2, bei dem das Vernetzungsmittel ein Melamin ist.

4. Ein Dünnfilm-Magnetkopf nach Anspruch 1 oder Anspruch 2, bei dem das Vernetzungsmittel ein Epoxid-Kresol-Novolackharz ist, welches einen latenten Katalysator enthält.

5. Ein Dünnfilm-Magnetkopf nach Anspruch 1 oder Anspruch 2, bei dem der Vernetzungsbeschleuniger ein Diazo-Beschleuniger ist.

6. Ein Dünnfilm-Magnetkopf nach jedem der vorhergehenden Ansprüche, bei dem das thermisch aktivierte Vernetzungsmittel oder der Beschleuniger 10 bis 50 Gewichts-% des Harzes ausmacht.

7. Ein Dünnfilm-Magnetkopf nach Anspruch 6, bei dem das thermisch aktivierte Vernetzungsmittel oder der Beschleuniger zwischen 20 bis 40 Gewichts-% des Harzes ausmachen.

## Revendications

1. Tête magnétique à couche mince (11) composée d'un isolant électrique entourant (22) une bobine électriquement conductrice (20), caractérisée en ce que l'isolant comprend une résine photosensible qui a été réticulée par un agent ou promoteur de réticulation activé thermiquement.

2. Tête magnétique à couche mince selon la revendication 1, dans laquelle la résine photosensible est une résine de novolaque.

vention, many variations of which will occur to those skilled in the art.

Different routes were employed to prepare thermally crosslinkable resists, depending on the type of crosslinking agent used. The first route made use of a melamine resin. To prepare an approximate 30 wt. % of melamine to novolac resin, 2g of hexamethoxymethylmelamine is added to 25g of a novolac based positive photo resist such as AZ1375 from Hoechst. With mixing, a homogeneous solution is attained. The thermally crosslinkable photo resist is ready for use.

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A resist was prepared from AZ1350J novolac resin to which 10% by weight of 4,4'-diazidodiphenylsulfide was added with thorough mixing. The resist containing the additive became hard-baked much faster than the resist without the additive.

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4. A thin film magnetic head as claimed in claim 1 or claim 2, in which the crosslinking agent is an epoxy cresol novolac resin containing a latent catalyst.

5. A thin film magnetic head as claimed in claim 1 or claim 2, in which the crosslinking promotor is of the bisazide type.

6. A thin film magnetic head as claimed in any preceding claim, in which the thermally activated crosslinking agent or promotor comprises from 10 to 50% by weight of the resin.

7. A thin film magnetic head as claimed in claim 6, in which the thermally activated crosslinking agent or promotor comprises from 20 to 40% by weight of the resin.

## Patentansprüche

1. Ein Dünnfilm-Magnetkopf (11) mit einer elektrischen Isolierung (22), die eine elektrisch leitfähige Spule (20) umgibt, dadurch gekennzeichnet, daß die Isolierung ein photoempfindliches Harz umfaßt, welches durch ein thermisch aktiviertes Vernetzungsmittel oder einen Beschleuniger vernetzt wurde.

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7. Ein Dünnfilm-Magnetkopf nach Anspruch 6, bei dem das thermisch aktivierte Vernetzungsmittel oder der Beschleuniger zwischen 20 bis 40 Gewichts-% des Harzes ausmachen.

## Revendications

1. Tête magnétique à couche mince (11) composée d'un isolant électrique entourant (22) une bobine électriquement conductrice (20), caractérisée en ce que l'isolant comprend une résine photosensible qui a été réticulée par un agent ou promoteur de réticulation activé thermiquement.

2. Tête magnétique à couche mince selon la revendication 1, dans laquelle la résine photosensible est une résine de novolaque.

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3. Tête magnétique à couche mince selon la revendication 1 ou 2, dans laquelle l'agent de réticulation est une mélamine.

4. Tête magnétique à couche mince selon la revendication 1 ou 2, dans laquelle l'agent de réticulation est une résine de novolaque époxy-crésol contenant un catalyseur latent.

5. Tête magnétique à couche mince selon la revendication 1 ou 2, dans laquelle le promoteur de réticulation est du type disazide.

6. Tête magnétique à couche mince selon l'une quelconque des revendications précédentes, dans laquelle l'agent ou le promoteur de réticulation activé thermiquement comprend de 10 à 50% par unité de poids de résine.

7. Tête magnétique à couche mince selon la revendication 6, dans laquelle l'agent ou le promoteur de réticulation activé thermiquement comprend de 20 à 40% par unité de poids de résine.