

DescriptionTechnical Field

5 This invention relates generally to thermal ink jet (TIJ) printing and more particularly to a new and improved integrated thermal ink jet printhead and novel method of manufacturing same.

Background Art

10 In the field of thermal ink jet printing, many present manufacturing processes use a chosen thin film processing technique to make the thin film resistor (TFR) substrate portion of the printhead and a separate orifice plate manufacturing technique to make the metal orifice plate having a desired number and geometry of ink ejection orifices therein. Then, using critical alignment techniques, the orifice plate is precisely aligned with the thin film resistor substrate in such a manner that the heater resistors of the TFR substrate
 15 are precisely aligned with the orifices in the orifice plate. Thus, the heater resistors are positioned to heat the ink in associated ink reservoirs which are usually aligned with both the heater resistors and the orifices in the orifice plate. In this fashion, the ink is heated to boiling and forced out of the orifices during a thermal ink jet printing operation. One such fabrication process of the type described above is disclosed in the Hewlett-Packard Journal, Vol. 38, Number 5, May 1985, incorporated herein by reference.

20 While the above Hewlett-Packard process has proven highly successful in most respects, it nevertheless does require the critical alignment between the orifice plate and the thin film resistor substrate, and it further requires separate processing to form the orifice plate and to form the thin film resistor substrate which are subsequently aligned.

Disclosure of Invention

25 It is an object of the present invention to provide a new and improved thermal ink jet printhead and process for manufacturing same wherein the above orifice plate processing and thin film resistor substrate processing have been combined into a single novel process sequence. This invention provides a relatively
 30 inexpensive and reliable manufacturing process for the large scale production of thermal ink jet printheads, and additionally overcomes the above critical alignment problem of the prior art.

Another object of this invention is to provide a new and improved integrated thermal ink jet printhead and associated manufacturing process wherein the ink jet printhead thus produced has a longer lifetime relative to currently available printheads.

35 A feature of this invention is the provision of an improved self-aligning process for building up the orifice plate and heater resistors in sequence on a dummy substrate. This process has been greatly simplified relative to currently available printhead orifice plate alignment processes.

Another feature of this invention is the provision of an alignment process which has a very precise alignment of three (3) critical parts of the ink jet printhead, and thus results in an improved performance of
 40 such printhead.

The above objects, features and advantages of this invention are accomplished herein by initially forming an orifice plate -e.g. using chosen electroforming techniques. Next, a thin film structure is formed on the orifice plate, including heater resistors, selectively spaced in a predefined configuration. According to a preferred embodiment, the orifice plate is formed on a reusable substrate, followed by a first insulating,
 45 barrier layer and then the resistors. A second insulating barrier layer is then deposited on the first barrier layer and extends over the heater resistors to protect these resistors from ink corrosion and cavitation wear. Then, an ink reservoir-defining layer is formed on the second barrier layer and has a plurality of ink reservoir openings therein which are aligned with openings in the orifice plate. Finally, the dummy substrate is mechanically separated from the orifice plate to unplug the openings in the orifice plate, and the ink
 50 reservoir-defining layer can now be secured to an ink supply chamber or pen body housing or the like. The process of the present invention is defined in claims 1 and 4.

The present invention is also directed to a printhead structure and an ink jet pen made by the above manufacturing process. These are defined in claims 9 and 12.

55 The above summary of invention and various objects, features and advantages thereof will become more readily apparent and understood from the following description of the accompanying drawings.

Brief Description of the Drawings

Figures 1-10 herein illustrate, in a sequence of schematic cross-section views, the preferred process and structural embodiments of this invention.

Description of the Preferred Embodiment

Referring now to Figure 1, the substrate starting material 10 may be either silicon or glass and will typically be 200-300 microns in thickness. A photoresist pattern 12 is formed in the geometry shown on the upper surface 14 of the substrate 10, and the photoresist mask 12 serves to define openings 16 in a subsequently deposited nickel pattern 18 which is electroformed on the exposed upper surface 14 in the geometry shown in Figure 2. This process of electroforming nickel on either silicon or glass is generally well known in the art of manufacturing orifice plates for thermal ink jet printheads and is disclosed, for example, in both the Hewlett-Packard Journal cited above and in U. S. Patent No. 4,694,308 issued to Chor S. Chan et al entitled "Barrier layer and Orifice Plate for Thermal Ink Jet Print Head Assembly", incorporated herein by reference.

Referring now to Figure 3, a first barrier layer 20 of an insulating film such as silicon nitride or silicon oxynitride or silicon dioxide is deposited on top of the nickel layer 18. Then a thin film resistor/conductor material 22 and 28 respectively which will perform both resistor and conductor functions of a heater resistor and a conductor when properly treated is deposited by sputtering on the upper surface of the insulating layer 20. The resistor portion is indicated as 22 and the conductor portion is indicated as 24, 26 and 28 in Figures 4A and 4B. This thin film resistor/conductor layer is patterned using conventional photoresist masking and etching processes. The thin pattern of resistive heater material 22 is formed in the circular geometry of Figures 4A and 4B and is integrally formed with lead-in conductors 24, 26 and 28 in the geometry shown in Figure 4B.

The circular strip 22 will be the heater resistor by virtue of the fact that it has more number of squares in a given area. That is, the resistance R of both heater resistor 22 and conductor material 24 is equal to $R_s L/A$, where R_s = sheet resistivity of material, L = length of material, and A = cross section area of material. That is: $R = R_s L/A$. Therefore, by the appropriate selection of the width and length of openings in the mask used to define the resistor portion (22) and conductor portion (24,26,28) of the integral resistor/conductor strip atop the insulating layer 20 in Figure 4A, the resistance of these segments of the resistor/conductor strip can be controlled as is known in the art.

Referring now to Figures 5A and 5B, a second barrier layer 30 is formed atop the resistor and conductor strips of Figure 4B, and this second barrier layer 30 is preferably a combination of silicon nitride and silicon carbide. The silicon nitride is initially deposited on the surface of Figure 4A and is followed by a subsequent deposition of silicon carbide so as to provide a highly inert composite $\text{Si}_3\text{N}_4/\text{SiC}$ second barrier layer 30. This barrier layer 30 protects the underlying material against ink corrosion and cavitation wear during an ink jet printing operation. The second barrier layer 30 is then selectively etched in the contact areas 32 and 34 of Figure 5B in order to enable electrical connections to be made to the underlying conductive trace material 24 and 26 for driving the heater resistors 22.

Referring now to Figure 6, a suitable seed strip or pad 36 such as titanium, chromium, or nickel is formed on the barrier layer 30 and photo defined by masking and etching in a well known manner. This seed material 36 is used to initiate the formation, by way of electrolytic deposition and/or electroplating, a larger overlying nickel pattern 38 which is grown in the annular dome shaped geometry shown in Figure 7. The nickel 38 is formed in the shape of partially open annular regions which define a plurality of ink reservoirs or ink chamber areas 40 and 42. These ink chambers 40 and 42 are indicated in Figure 7 and are aligned with the previously formed openings 16 in the nickel orifice plate 18.

The orifice plate 18 along with its adjacent layers of insulating and conducting films can now be separated from the substrate 10 by peeling it off from the same. The substrate 10 basically performs the function of a temporary support substrate for the orifice plate 18 during the process of fabrication and definition of the various thin film layers. This substrate 10 can be used over and over again in the above described process. In the above process of peeling off the orifice plate 18 from the substrate 10, the areas 43 and 45 of the multiple insulating layers on top of the photoresist pads are pulled away from the orifice plate in Figure 7 along with the photoresist pads 12, thereby leaving openings 44 and 46 in the orifice plate structure shown in Figure 8. The openings 44 and 46 thus formed will therefore be initially left here with the ragged edges shown in Figure 8, but these edges 44 and 46 may be subsequently cleaned off and smoothed out by a mechanical operation such as the use of a light sandblasting with fine grit or plasma erosion.

Figure 9B is a plan view of a preferred embodiment of the invention and shown rotated ninety (90) degrees with respect to the plan views of Figs. 4B and 5B, and Fig. 9A is a cross section view taken along lines A-A of Fig. 9B. The annular shaped domes 38 which serve to define the ink reservoirs or chambers 40 associated with each orifice opening are provided with the ink flow ports. These ports will typically communicate with a common ink feed path from a remote common ink supply opening (not shown) in a central region of the substrate 18. This common ink supply opening may take the form of an elongated slot which may be defined by known masking and sandblasting procedures. Such ink feed slots and methods for forming same are described respectively, for example, in U.S. Patent No. 4,680,859 of Samuel A. Johnson entitled "Thermal Ink Jet Printhead and Method of Manufacture" and in U.S. Patent Application Serial No. 052,630 of James Pollacek et al entitled "Precision Milling of Materials", both of which are assigned to the present assignee and incorporated herein by reference.

Next, the structure of Figure 9 may be secured to a larger ink supply chamber 48 as shown in Figure 10 using known soldering processes to permanently join the outside wall of the chamber 48 to the metal domes 38. The larger chamber 48 is operative to feed ink in the direction of the arrows and to individual ones of the ink chambers 40 and 42 in the integrated thermal ink jet printhead in Figure 9. Electrical connection means 50, 52 may be mounted on the outer surface of the large ink reservoir 48 to provide pulse drive circuitry for the printhead of Figure 9. For example, an insulating substrate 50 will typically carry electrical leads 52 thereon (or therein), and in actual practice may take the form of a flexible (FLEX) circuit or a tape automated bond (TAB) bond circuit of the types well known in the art. The individual electrical leads 52 in such circuits may be connected into the printhead conductors 24, 26, 28 using known wire or beam lead bonding techniques (not shown), and one such suitable single point TAB bonding process is disclosed, for example, in U.S. Patent No. 4,635,073 issued to Gary E. Hanson, assigned to the present assignee and incorporated herein by reference.

The following table of values indicates suitable layer deposition processes, layer thicknesses, and materials which may be used in printhead manufacture in accordance with the presently known best mode for carrying out the present invention. However, it should be understood that this table is given by way of example only, and it is not intended to indicate any single absolute best process for manufacturing our printhead, since one single set of preferred process steps and related details have not been selected as of the present time.

TABLE

LAYER	SUITABLE MATERIAL	DEPOSITION PROCESS	THICKNESS (MICRONS)
Substrate (10)	Oxidized Silicon Glass		200 - 300
Orifice Plate (18)	Nickel	Plating	20 - 75
Insulating Layer (20)	Silicon Dioxide Silicon Nitride Silicon Oxy nitride	PECVD * LPCVD **	1 to 3
Resistor/Conductor (22)	Polysilicon Tantalum Silicide Gold	Sputtering PECVD LPCVD	0.05 to 0.5
Passivation Layer (30)	Silicon Dioxide Silicon Nitride Silicon Oxy nitride Silicon Carbide	PECVD LPCVD	0.5 to 2
Seed Layer (36)	Nickel, Titanium Chromium	Sputtering	0.5 to 2
Barrier (38)	Nickel	Plating	10 to 75

* Plasma Enhanced Chemical Vapor Deposition

** Low Pressure Chemical Vapor Deposition

In the above table, PECVD signifies plasma enhanced chemical vapor deposition, whereas LPCVD signifies low pressure chemical vapor deposition. These processes are generally well known in the thin film art and are therefore not described in further detail herein. However, for a further discussion of these or related thin film technologies, reference may be made to the following three books on thin film technology:

- (1) Berry, Hall and Harris, Thin Film Technology, Van Nostrand Reinhold Co., New York, 1968.
- (2) Maissel and Glang, Handbook of Thin Film Technology, McGraw Hill Book Co., New York, 1970.
- (3) Vossen and Kern, Thin Film Processes, Academic Press, New York, 1978.

Thus, there has been described a thermal ink jet printhead which is fabricated in its entirety on one supporting dummy substrate which may be reusable many times, thereby reducing the manufacturing cost of the ink jet printhead. The masking steps used in the manufacture of the ink jet printhead described herein comes to a total of four (4) as compared to six (6) steps using the previously known processes for separately forming a thin film resistor substrate and a matching metal orifice plate, respectively. In the prior art processes, the orifice plate and the heater resistors are fabricated on different substrates and thus have to be precisely aligned with each other, resulting in a time consuming and difficult operation. However, in accordance with the present invention, all of the critical parts of the ink jet printhead which require precise alignment, namely the orifice plate, the ink jet chambers and the heater resistors are all formed on the same substrate, thereby providing a novel self-aligning process. The precise alignment of the above three (3) critical parts result in a precisioned thin film structure capable of improved performance in terms of printhead life and ink drop trajectory. After the ink drops are ejected from the orifices of the above-described printhead, the collapsing ink meniscus at the orifice travels toward the ink supply chamber instead of directly at the heater resistor. In this manner, the heater resistors are not subject to direct cavitation forces during an ink jet printing operation, and thus the life of the ink jet printhead is substantially enhanced.

Claims

1. A self-aligning process for manufacturing a thermal ink jet printhead including the steps of:
 - a. providing a reusable substrate (10);
 - b. forming an orifice plate (18) on said substrate;
 - c. forming a first barrier (20) layer on said orifice plate;
 - d. forming heater resistors (22) on said first barrier layer in a predefined configuration and spacing relative to openings (16) in said orifice plate;
 - e. forming conductors (24,26,28) connected to the resistors (22) for providing current thereto;
 - f. forming a second barrier layer (30) on said first barrier layer (20) and extending over said heater resistors (22) to protect said heater resistors from ink corrosion and cavitation wear;
 - g. forming an ink reservoir-defining layer (38) on said second barrier layer (30) and having a plurality of ink reservoir openings (40,42) aligned with openings (16) in said orifice plate (18);
 - h. providing passages (44,46) through said first and second barrier layers (20,30) and extending from said reservoirs (40,42) and to openings (16) in said orifice plate (18), whereby said ink reservoir layer (38) may be secured to an ink supply chamber (48) for supplying ink to said plurality of ink reservoirs; and
 - i. removing said reusable substrate (10) from said orifice plate.
2. The process defined in claim 1 which further includes affixing an ink supply chamber (48) to said reservoir-defining layer (38) for providing ink to each of said reservoirs from a common source of ink supply.
3. The process defined in claim 1 or claim 2 which includes forming heater resistors (22) integral with lead-in conductors (24,26,28) on the surface of said first barrier layer (20) and controlling the resistor/conductor resistance by controlling the cross-section areas of the resistor/conductor material.
4. A process for manufacturing an ink jet pen which includes:
 - a. forming an orifice plate (18) on a reusable substrate (10);
 - b. forming a thin film transducer structure on said orifice plate (18) and including conductors (24,26,28) leading into heater resistors (22) in a predefined spacing relative to openings (16) in said orifice plate (18);
 - c. forming ink-reservoir defining walls (38) adjacent to said transducers (22);
 - d. removing said substrate (10);

In the above table, PECVD signifies plasma enhanced chemical vapor deposition, whereas LPCVD signifies low pressure chemical vapor deposition. These processes are generally well known in the thin film art and are therefore not described in further detail herein. However, for a further discussion of these or related thin film technologies, reference may be made to the following three books on thin film technology:

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Thus, there has been described a thermal ink jet printhead which is fabricated in its entirety on one supporting dummy substrate which may be reusable many times, thereby reducing the manufacturing cost of the ink jet printhead. The masking steps used in the manufacture of the ink jet printhead described herein comes to a total of four (4) as compared to six (6) steps using the previously known processes for separately forming a thin film resistor substrate and a matching metal orifice plate, respectively. In the prior art processes, the orifice plate and the heater resistors are fabricated on different substrates and thus have to be precisely aligned with each other, resulting in a time consuming and difficult operation. However, in accordance with the present invention, all of the critical parts of the ink jet printhead which require precise alignment, namely the orifice plate, the ink jet chambers and the heater resistors are all formed on the same substrate, thereby providing a novel self-aligning process. The precise alignment of the above three (3) critical parts result in a precisioned thin film structure capable of improved performance in terms of printhead life and ink drop trajectory. After the ink drops are ejected from the orifices of the above-described printhead, the collapsing ink meniscus at the orifice travels toward the ink supply chamber instead of directly at the heater resistor. In this manner, the heater resistors are not subject to direct cavitation forces during an ink jet printing operation, and thus the life of the ink jet printhead is substantially enhanced.

25 Claims

1. A self-aligning process for manufacturing a thermal ink jet printhead including the steps of:
 - a. providing a reusable substrate (10);
 - b. forming an orifice plate (18) on said substrate;
 - 30 c. forming a first barrier (20) layer on said orifice plate;
 - d. forming heater resistors (22) on said first barrier layer in a predefined configuration and spacing relative to openings (16) in said orifice plate;
 - e. forming conductors (24,26,28) connected to the resistors (22) for providing current thereto;
 - f. forming a second barrier layer (30) on said first barrier layer (20) and extending over said heater resistors (22) to protect said heater resistors from ink corrosion and cavitation wear;
 - 35 g. forming an ink reservoir-defining layer (38) on said second barrier layer (30) and having a plurality of ink reservoir openings (40,42) aligned with openings (16) in said orifice plate (18);
 - h. providing passages (44,46) through said first and second barrier layers (20,30) and extending from said reservoirs (40,42) and to openings (16) in said orifice plate (18), whereby said ink reservoir layer (38) may be secured to an ink supply chamber (48) for supplying ink to said plurality of ink reservoirs; and
 - 40 i. removing said reusable substrate (10) from said orifice plate.
2. The process defined in claim 1 which further includes affixing an ink supply chamber (48) to said reservoir-defining layer (38) for providing ink to each of said reservoirs from a common source of ink supply.
3. The process defined in claim 1 or claim 2 which includes forming heater resistors (22) integral with lead-in conductors (24,26,28) on the surface of said first barrier layer (20) and controlling the resistor/conductor resistance by controlling the cross-section areas of the resistor/conductor material.
- 50 4. A process for manufacturing an ink jet pen which includes:
 - a. forming an orifice plate (18) on a reusable substrate (10);
 - b. forming a thin film transducer structure on said orifice plate (18) and including conductors (24,26,28) leading into heater resistors (22) in a predefined spacing relative to openings (16) in said orifice plate (18);
 - 55 c. forming ink-reservoir defining walls (38) adjacent to said transducers (22);
 - d. removing said substrate (10);



- e. bonding said walls to an ink supply container (48); and
- f. electrically connecting said conductors to mating leads on said container for providing current to said transducers.

- 5 5. The process defined in claim 4 wherein said ink reservoir defining walls (38) are electroformed in a pattern on said thin film transducer structure and subsequently bonded to said ink supply container (48).
- 10 6. The process defined in claim 5 wherein orifice openings (16) in said thin film transducer structure are made by selective electroforming on top of said reusable substrate (10).
- 15 7. The process defined in claim 4 wherein said transducers are formed by depositing a plurality of resistors (22) in partially encircling geometry surrounding a corresponding plurality of orifices (16) in said thin film transducer structure and integrally joined with a plurality of lead-in conductors (24,26,28).
- 20 8. The process defined in claim 7 wherein said walls are electroformed to partially surround said resistors (22) and provide ink flow thereto.
- 25 9. An integrated thermal ink jet printhead comprising:
 - a. an orifice plate (18) having plurality of openings (16) therein;
 - b. a thin film structure formed on said orifice plate (18) and including:
 - c. a first barrier layer (20) disposed on said orifice plate;
 - d. a plurality of heater resistors (22) arranged in a predefined configuration on said first barrier layer (20) and positioned adjacent said openings (16) in said orifice plate;
 - e. conductors (24,26,28) connected to the resistors (22) for providing current thereto;
 - f. a second barrier layer (30) disposed on said first barrier layer (20) and covering said heater resistors (22) and protecting same from ink corrosion and cavitation wear; and
 - 30 g. an ink reservoir-defining layer (38) disposed on said second barrier (30) layer and having a plurality of ink reservoirs (40,42) therein aligned with said openings (16) in said orifice plate;
 - h. said first and second barrier layers (20,30) having a passageway (44,46) extending therethrough at each opening in said orifice plate for providing an ink flow path from said reservoirs (40,42) in said reservoir-defining layer and through openings (16) in said orifice plate, whereby said ink reservoir defining layer (38) may be secured to an ink supply chamber (48) or housing for supplying ink to said reservoirs (40,42) and through said openings (16) in said orifice plate (18) during an ink jet printing operation.
- 35 10. The structure defined in claim 9 which further includes an ink supply chamber (48) affixed to said ink reservoir-defining layer (38) for supplying ink from a common source of ink supply to each of said reservoirs (40,42).
- 40 11. The structure defined in claim 9 or claim 10 wherein said heater resistors (22) are formed integral with lead-in conductors (24,26,28), the resistance of which is controlled in accordance with their established cross sectional area.
- 45 12. An ink jet pen including in combination:
 - a. an orifice plate (18) having a plurality of openings (16) therein;
 - b. a thin film transducer structure formed on said orifice plate (18) having conductors (24,26,28) thereon leading into heater resistors (22) which partially surround said orifices (16);
 - c. annular walls (38) adjacent said resistors and defining ink reservoirs (40,42) therefor, said walls (38) are electroformed to have ink flow ports therein for supplying ink to said resistors (22);
 - 50 d. an ink container (48) bonded to said annular walls (38); and
 - e. means (50,52) on said container for providing an external electrical connection to said conductors on said thin film transducer structure.
- 55 13. The pen defined in claim 12 wherein said heater resistors (22) are integrally joined to lead in conductors (24,26,28).



Patentansprüche

1. Sich selbst abstimmendes Verfahren zum Herstellen eines thermischen Tintenstrahldruckkopfes, umfassend die Schritte:
 - a. Bereitstellen eines wiederverwendbaren Substrates (10);
 - b. Bilden einer Düsenplatte (18) auf dem Substrat;
 - c. Bilden einer ersten Sperrschicht (20) auf der Düsenplatte;
 - d. Bilden von Heizwiderständen (22) auf der ersten Sperrschicht in einer vorbestimmten Konfiguration und in vorbestimmtem Abstand relativ zu den Öffnungen (16) in der Düsenplatte;
 - e. Bilden von Leitern (24, 26, 28), welche mit den Widerständen (22) verbunden sind, um einen Stromfluß durch diese zu ermöglichen;
 - f. Bilden einer Zweiten Sperrschicht (30) auf der ersten Sperrschicht (20) über die Heizwiderstände (22) zum Schützen der Heizwiderstände gegen Tintenkorrosion und Gravitations-Verschleiß;
 - g. Bilden einer Tintenreservoir eingrenzenden Schicht (38) auf der zweiten Sperrschicht (30) mit mehreren Tintenreservoiröffnungen (40, 42), die auf Öffnungen (16) in der Düsenplatte (18) ausgerichtet sind;
 - h. Schaffen von Durchlässen (44, 46) durch die erste und die zweite Sperrschicht (20, 30), die sich von den Reservoir (40, 42) zu Öffnungen (16) in der Düsenplatte (18) erstrecken, wodurch die Tintenreservoirschicht (38) an einer Tintenspeisekammer (48) zum Speisen von Tinte zu den Tintenreservoirn gesichert wird; und
 - i. Entfernen des wiederverwendbaren Substrats (10) von der Düsenplatte.
2. Verfahren nach Anspruch 1, umfassend das Befestigen einer Tintenspeisekammer (48) zu der tintenreservoirbildenden Schicht (38) zum Führen von Tinte zu jedem der Reservoir aus einer gemeinsamen Quelle für Tinte.
3. Verfahren nach einem der Ansprüche 1 oder 2, welches das Bilden von Heizwiderständen (22) einstückig mit den Leitern (24, 26, 28) auf der Oberfläche auf der ersten Sperrschicht (20) und das Kontrollieren des Widerstand-/Leiterwiderstandes durch Kontrollieren der Querschnittsfläche des Widerstand-/Leitermaterials umfaßt.
4. Verfahren zum Herstellen eines Tintenstrahlschreibers, umfassend:
 - a. Bilden einer Düsenplatte (18) auf einem wiederverwendbaren Substrat (10);
 - b. Bilden einer Dünnschicht-Transducer-Struktur auf der Düsenplatte (18) einschließlich von Leitern (24, 26, 28), die in Heizwiderstände (22) in vorbestimmten Abstand relativ zu Öffnungen (16) in der Düsenplatte (18) führen;
 - c. Bilden von tintenreservoirbegrenzenden Wänden (38) benachbart den Transducern (22);
 - d. Entfernen des Substrats (10);
 - e. Anborden der Wände an einen Tintenspeisebehälter (48); und
 - f. elektrisches Verbinden der Leiter mit dazu fluchtenden Leitern an dem Behälter zum Stromversorgen der Transducer.
5. Verfahren nach Anspruch 4, bei dem die tintenreservoirbildenden Wände (38) in einem Muster auf der Dünnschicht-Transducer-Struktur elektrogeformt und anschließend an dem Tintenspeisebehälter (48) angebondet werden.
6. Verfahren nach Anspruch 5, bei dem Düsenöffnungen (16) in der Dünnschicht-Transducer-Struktur durch selektives Elektroformen auf der Oberseite des wiederverwendbaren Substrates (10) geformt werden.
7. Verfahren nach Anspruch 4, bei dem die Transducer durch Ablagern mehrerer Widerstände (22) in teilweise einkreisender Geometrie, umgebend eine entsprechende Anzahl von Düsen (16) in der Dünnschicht-Transducer-Struktur, ausgebildet und einteilig mit mehreren Leitern (24, 26, 28) verbunden werden.
8. Verfahren nach Anspruch 7, bei dem die Wände so elektrogeformt werden, daß sie die Widerstände (22) teilweise umgeben und einen Tintenfluß dorthin zulassen.
9. Integrierter thermischer Tintenstrahldruckkopf umfassend:



- a. eine Düsenplatte (18) mit mehreren Öffnungen (16) darin;
 b. eine Dünnschicht-Struktur, welche auf der Düsenplatte (18) ausgebildet ist und umfaßt;
 c. eine erste Sperrschicht (20), die auf der Düsenplatte ausgebildet ist;
 d. mehrere Heizwiderstände (22), die in vorbestimmter Anordnung auf der ersten Sperrschicht (20) gruppiert und benachbart den Öffnungen (16) in der Düsenplatte angeordnet sind;
 e. Leiter (24, 26, 28), welche mit den Widerständen (22) für deren Stromdurchfluß verbunden sind;
 f. eine zweite Sperrschicht (30), welche auf der ersten Sperrschicht (20) angeordnet ist und die Heizwiderstände (22) abdeckt und diese vor Tintenkorrosion und Gravitationsverschleiß schützt; und
 g. eine tintenreservoirbildende Schicht (38), welche auf der zweiten Sperrschicht (30) angeordnet ist und mehrere Tintenreservoirs (40, 42) darin eingrenzt, welche auf die Öffnungen (16) in der Düsenplatte ausgerichtet sind;
 h. wobei die erste und die zweite Sperrschicht (20, 30) Durchlässe (44, 46) bei jeder Öffnung in der Düsenplatte haben, um einen Tintenstropfpfad aus den Reservoirs (40, 42) in der reservoirbildenden Schicht und durch die Öffnungen (16) in der Düsenplatte zu schaffen, wobei die tintenreservoirbildende Schicht (38) an einer Tintenspeisekammer (48) oder einem Gehäuse zum Speisen von Tinte gesichert ist, um Tinte zu den Reservoirs (40, 42) und durch die Öffnungen (16) in der Düsenplatte (18) während eines Tintenstrahldruckvorganges zu speisen.
10. Struktur nach Anspruch 9, umfassend eine Tintenspeisekammer (48), die an der tintenreservoirbildenden Schicht (38) befestigt ist, um Tinte aus einer gemeinsamen Quelle eines Tintenvorrats zu jedem der Reservoirs (40, 42) zu speisen.
11. Struktur nach Anspruch 9 oder 10, bei der die Heizwiderstände (22) einstückig mit den Leitern (24, 26, 28) geformt sind, wobei deren Widerstand über deren Herstellquerschnittsflächen gesteuert ist.
12. Tintenstrahlschreiber, der in Kombination aufweist:
 a. eine Düsenplatte (18) mit mehreren Öffnungen (16) darin;
 b. eine Dünnschicht-Transducer-Struktur, welche auf der Düsenplatte (18) ausgebildet ist und Leiter (24, 26, 28) darin enthält, welche zu Heizwiderständen (22) führen, welche ihrerseits die Öffnungen (16) teilweise umgeben;
 c. Ringwände (38) benachbart der Widerstände, welche Tintenreservoirs (40, 42) bilden, wobei die Wände (38) mit Tintenstromöffnungen elektrogeformt sind, um Tinte zu den Widerständen (22) zu leiten;
 d. einen Tintenbehälter (48), der an die Ringwände (38) angebondet ist; und
 e. Mittel (50, 52) an dem Behälter zum Schaffen einer externen elektrischen Verbindung zu den Leitern auf der Dünnschicht-Transducer-Struktur.
13. Schreiber nach Anspruch 12, bei den die Heizwiderstände (22) einteilig mit den Leitern (24, 26, 28) verbunden sind.

Revendications

1. Procédé d'auto-alignement pour fabriquer une tête d'impression à jet d'encre thermique, comprenant les phases consistant à :
- a. préparer un substrat réutilisable (10);
 b. former une plaque à orifices (18) sur ledit substrat ;
 c. former une première couche barrière (20) sur ladite plaque à orifices ;
 d. former des résistances chauffantes (22) sur ladite première couche barrière, dans une configuration prédéfinie et à un espacement prédéfini par rapport aux ouvertures (16) de ladite plaque à orifices ;
 e. former des conducteurs (24, 26, 28) connectés aux résistances (22) pour leur fournir un courant ;
 f. former une deuxième couche barrière (30) placée sur ladite première couche barrière (20) et s'étendant au-dessus desdites résistances chauffantes (22) pour protéger lesdites résistances chauffantes de la corrosion par l'encre et de l'usure par cavitation ;
 g. former une couche (38) définissant des réservoirs d'encre sur ladite deuxième couche barrière (30) et ayant une pluralité d'ouvertures (40, 42) de réservoirs d'encre alignées sur les ouvertures (16) de ladite plaque à orifices (18) ;



- h. former des passages (44, 46) à travers lesdites premières et deuxième couches barrières (20, 30), partant desdits réservoirs (40, 42) et aboutissant aux ouvertures (16) de ladite plaque à orifices (18), ladite couche de réservoirs d'encre (38) pouvant être fixée à une chambre (48) d'alimentation en encre pour acheminer l'encre à ladite pluralité de réservoirs d'encre ; et
- i. séparer ledit substrat réutilisable (10) de ladite plaque à orifices.
2. Procédé selon la revendication 1, qui comprend la phase consistant à fixer une chambre (48) d'alimentation en encre à ladite couche (38) définissant les réservoirs pour acheminer de l'encre à chacun desdits réservoirs en partant d'une source commune d'alimentation en encre.
3. Procédé selon la revendication 1 ou la revendication 2, qui comprend la phase consistant à former des résistances chauffantes (22) d'un seul tenant avec des conducteurs d'amenée (24, 26, 28) sur la surface de ladite première couche barrière (20) et commander la résistance ohmique entre les résistances et les conducteurs en agissant sur les surfaces de section de la matière des résistances et des conducteurs.
4. Procédé de fabrication d'une plume à jet d'encre qui comprend les phases consistant à :
- a. former une plaque à orifices (18) sur un substrat réutilisable (10) ;
 - b. former une structure de transducteur en film mince sur ladite plaque à orifices (18), comprenant des conducteurs (24, 26, 28) aboutissant aux résistances chauffantes (22) avec un espacement prédéfini par rapport à des ouvertures (16) de ladite plaque à orifices (18) ;
 - c. former des parois (38) définissant des réservoirs d'encre adjacentes audit transducteur (22) ;
 - d. enlever ledit substrat (10) ;
 - e. assembler lesdites parois à un conteneur (48) d'alimentation en encre ; et
 - f. connecter électriquement lesdits conducteurs à des conducteurs correspondants prévus sur ledit conteneur pour transmettre le courant auxdits transducteurs.
5. Procédé selon la revendication 4, dans lequel lesdites parois (38) définissant les réservoirs d'encre sont électroformées dans un dessin prévu sur ladite structure de transducteur en film mince, puis assemblées audit conteneur (48) d'alimentation en encre.
6. Procédé selon la revendication 5, dans lequel des ouvertures (16) formant les orifices, prévues dans ladite structure de transducteurs en film mince sont formées par électroformage sélectif sur la face supérieure dudit substrat réutilisable (10).
7. Procédé selon la revendication 4, dans lequel lesdits transducteurs sont formés en déposant une pluralité de résistances (22) dans une géométrie partiellement encerclante qui entoure une pluralité correspondante d'orifices (16) prévue dans ladite structure de transducteurs en film mince et réunies en un seul tenant à une pluralité de conducteurs d'amenée (24, 26, 28).
8. Procédé selon la revendication 7, dans lequel lesdites parois sont électroformées pour entourer partiellement lesdites résistances (22) et conduire un écoulement d'encre vers ces dernières.
9. Tête d'impression à jet d'encre thermique intégrée, comprenant :
- a. une plaque à orifices (18) ayant une pluralité d'ouvertures (16) qui y sont formées ;
 - b. une structure de films minces formée sur ladite plaque à orifices (18) et comprenant :
 - c. une première couche barrière (20) disposée sur ladite plaque à orifices ;
 - d. une pluralité de résistances chauffantes (22) agencées dans une configuration prédéfinie sur ladite couche barrière (20) et positionnées adjacentes auxdites ouvertures (16) de ladite plaque à orifices ;
 - e. des conducteurs (24, 26, 28) connectés aux résistances (22) pour leur fournir un courant ;
 - f. une deuxième couche barrière (30) disposée sur ladite première couche barrière (20) et qui recouvre lesdites résistances chauffantes (22) et protège ces dernières de la corrosion par l'encre et de l'usure par cavitation ; et
 - g. une couche (38) définissant des réservoirs d'encre disposée sur la deuxième couche barrière (30) et ayant une pluralité de réservoirs d'encre (40, 42) qui y sont formés et sont alignés sur lesdites ouvertures (16) de ladite plaque à orifices ;
 - h. lesdites première et deuxième couches barrières (20, 30) ayant un passage (44, 46) qui les traverse à chaque ouverture de ladite plaque à orifices pour former un trajet d'écoulement de l'encre



partant desdits réservoirs (40, 42) formés dans ladite couche définissant les réservoirs et passant par les ouvertures (16) de ladite plaque à orifices, ladite couche (38) définissant les réservoirs d'encre pouvant être fixée à une chambre (48) ou un logement d'alimentation en encre servant à fournir l'encre auxdits réservoirs (40, 42) et à travers lesdites ouvertures (16) de ladite plaque à orifices (18) pendant une opération d'impression à jet d'encre.

10. Structure selon la revendication 9, qui comprend en outre une chambre (48) d'alimentation en encre fixée à ladite couche (38) définissant les réservoirs d'encre, pour acheminer l'encre d'une source commune d'alimentation en encre à chacun desdits réservoirs (40, 42).

11. Structure selon la revendication 9 ou la revendication 10, dans laquelle les résistances chauffantes (22) sont formées d'un seul tenant avec des conducteurs d'amenée (24, 26, 28) dont la résistance ohmique est commandée en fonction de leur surface de section établie.

12. Plume à jet d'encre comprenant en combinaison :

- a. une plaque à orifices (18) présentant une pluralité d'ouvertures (16) ;
- b. une structure de transducteurs en film mince formée sur ladite plaque à orifices (18) et portant sur elle des conducteurs (24, 26, 28) qui aboutissent dans des résistances chauffantes (22) qui entourent partiellement lesdits orifices (16) ;
- c. des parois annulaires (38) adjacentes auxdites résistances et définissant des réservoirs d'encre (40, 42) pour ces résistances, lesdites parois (38) étant électroformées de manière à renfermer des orifices d'écoulement d'encre servant à acheminer de l'encre auxdites résistances (22) ;
- d. un conteneur à encre (48) assemblé auxdites parois annulaires (38) ; et
- e. des moyens (50, 52) prévus sur ledit conteneur pour établir une connexion électrique extérieure avec lesdits conducteurs prévus sur ladite structure de transducteurs en film mince.

13. Plume selon la revendication 12, dans laquelle lesdites résistances chauffantes (22) sont réunies en un seul tenant à des conducteurs d'amenée (24, 26, 28).

