

A TAPE CASTING MACHINE

FIELD OF INVENTION

5 The present invention relates to a tape casting machine.

BACKGROUND OF INVENTION

10 Tape casting is a well known technique of fabricating thin ceramic substrates for a wide range of applications including multilayers capacitors, solid oxide fuel cells, sensors and so on. A typical length of commercially available tape casting is at least four metres long and a metre wide. It is usually a stand alone unit with at least a metre in width. It is an expensive ceramic processing equipment, costing over US\$ 150, 000.00 to acquire, commission and operate. It also needs a long extraction fume hood and large laboratory space.

15

US6375451 B1 describes a tape casting machine with a casting base with a static reservoir and doctor blade. However, the size of the machine is bulky and takes up a large footprint.

20 Therefore, there is a need for a more efficient apparatus to produce thinner ceramic tapes without using a large footprint and in a more energy efficient manner.

SUMMARY OF INVENTION

Accordingly, there is provided a tape casting machine, characterized in that, the machine includes a movable reservoir containing slurry; and at least one doctor blade disposed within
5 the moveable reservoir such that the doctor blade is controllable with a magnetic switch, wherein the slurry is passed on to non sticking transparency on a flat surface.

The present invention consists of several novel features and a combination of parts hereinafter fully described and illustrated in the accompanying description and drawings, it
10 being understood that various changes in the details may be made without departing from the scope of the invention or sacrificing any of the advantages of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

15 The present invention will be fully understood from the detailed description given herein below and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, wherein:

Figure 1 shows a dimensional view of a tape casting machine in the preferred embodiment of the invention; and

20 Figure 2 shows a graphical view of thickness of the tape cast alumina versus casting rate for difference blade gaps in the preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention relates to a tape casting machine. Hereinafter, this specification will
25 describe the present invention according to the preferred embodiment of the present

invention. However, it is to be understood that limiting the description to the preferred embodiment of the invention is merely to facilitate discussion of the present invention and it is envisioned that those skilled in the art may devise various modifications and equivalents without departing from the scope of the appended claims.

5

The following detailed description of the preferred embodiment will now be described in accordance with the attached drawings, either individually or in combination.

Figure 1 shows the preferred embodiment of a tape casting machine (100). The machine
10 (100) includes a movable reservoir (111) containing slurry and at least one doctor blade (101) disposed within the moveable reservoir (111) such that the doctor blade (101) is controllable with a magnetic switch (103), wherein the slurry is passed on to non sticking transparency (105) on a flat surface (109).

15 In conventional tape casting machines, the reservoir for slurries together with doctor blade controlling the thickness is stationary. In the preferred embodiment of the present invention as depicted in Figure 1, the moveable reservoir (111) and the doctor blade (101) are not stationary. The moveable reservoir (111) moves at different speed and dispenses the ceramic slurries on a transparency (thin plastic sheet) (105). The transparency (105) is
20 placed on the flat surface (107), such as a flat plate and held flat with some clamps. The flat surface (107) includes a flat glass, plastic plate or light metal tray such as aluminium. Ceramic tape is easily removable from the transparency (105) placed on the flat surface (107) without damage.

25 The ceramic slurries pass through an aperture, wherein height of the aperture controls the thickness of the ceramic tape. The height of the aperture is set with a micrometer as can be seen in Figure 1. Opening and closing of the shutter can be done manually or electronically using a magnetic switch (103) as shown in Figure 1. A parallel printer port to connect with

control circuits for controlling the magnetic switch (103) and the stepper motor (109) is used. A small transformer with various AC outputs is rectified for various operations of the tape casting machine (100). The use of such a mini size tape casting machine straight from the mains render the machine more compact and further optimize the use of the tape casting machine (100).

Speed with which the moveable reservoir (111) of ceramic slurries moves is controlled by a stepping motor (109) as shown in Figure 1. A circuit is designed to produce a stepping voltage of 5/6 volt. Frequency of square pulses can be varied to change the speed of the stepping motor (109). Accurate control of the speed of casting the ceramic slurries is achieved using the stepper motor (109) attached to a moving rail.

The speed with which the tray containing the ceramic slurries moves is the speed with which the ceramic slurries are dispensed through the aperture. The faster the speed of the tray, the thinner the ceramic tape produced. The speed of the tray is controlled by the stepper motor (109) (see Figure 1). Other factors such as, but not restricted to, the viscosities of the slurries, slurry density (solid content) and the height of the aperture (gap) control the speed of the tray as well. It is found that keeping the ceramic slurry viscosity constant at 3000 mPa.s, and varying the speed of the tray between 4 mm/sec and 34 mm/sec produces ceramic tape of good surface finish and reproducible thicknesses. Alumina tape is formed at center of the tape casting machine (100).

Results of studies on analytical grade alumina from Fluka for 3 blade gap and different casting speed of the slurries gap is depicted in Figure 2. It can be seen for gap blade of 0.25 mm, and higher casting speed, the tape thickness is quite uniform. The experiments to date show that tape thickness of 0.1 mm or 100 micron can be obtained reproducibly. It is also been found that casting speed below 3mm/sec produces tape of very rough surfaces and for

casting speed above about 34 mm/sec produces ceramic tapes with variable thickness and poor reproducibility.

The machine (100) is a low cost, compact tape casting machine of not more than 35 cm long, 14 cm high, and 15 cm wide. The machine (100) can be easily accommodated on a work bench. The machine (100) requires minimal laboratory space; not more than 575 sq.cm in superficial area. The machine (100) has commercial implications and applications in laboratories where space is at a premium, where precious and rare earth materials are used to minimize losses during materials processing and forming.

Applications of the tape casting machine (100) are in countries and laboratories where limited funds are available for research and development particularly in emerging and developing economies, start up companies requiring extensive materials processing prior to selection of materials for specific applications. The tape casting machine (100) has been successfully used to produce thin ceramic tapes of 100 micron thick with high degree of reproducibility and surface finish either by manual operation or by computer controlled route. Materials such as alumina, titania, and some novel compositions formulated have been experimented with successfully.

This invention is adapted for use for use in compact tape casting process for producing thin ceramic layers for solid oxide fuel cells will enable the development of low cost solid oxide fuel cells as alternative power generation system for dispersed application. The disclosed invention is suitable, but not restricted to, for use in a wide variety of applications in the electronic and chemical industries.

CLAIMS

1. A tape casting machine (100), characterized in that, the machine (100) includes:
a movable reservoir (111) containing slurry; and
at least one doctor blade (101) disposed within the moveable reservoir (111) such that
5 the doctor blade (101) is controllable with a magnetic switch (103), wherein the slurry is
passed on to non sticking transparency (105) on a flat surface (109).
2. The machine (100) as claimed in claim 1, wherein the machine (100) is capable of
forming ceramic tapes of uniform thickness.
10
3. The machine (100) as claimed in claim 1, wherein at least one doctor blade (101) is
controllable manually or electronically.
4. The machine (100) as claimed in claim 1, wherein the moveable reservoir (111) is
15 controllable by a stepper motor (109).
5. The machine (100) as claimed in claim 1, wherein optimal casting speed for slurries as
between 10mm/ sec and 30mm/sec to produce smooth surface finish and uniform
thickness.
20
6. The machine (100) as claimed in claim 1, wherein the flat surface (107) includes a flat
glass, plastic plate or light metal tray such as aluminium.
7. The machine (100) as claimed in claim 1, wherein ceramic tape is easily removable from
25 the transparency (105) placed on the flat surface (107) without damage.