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Analyzing method

Abstract

A method includes providing a jig including a predetermined center and a magnetron installed on the jig; rotating the magnetron and obtaining a measured first magnetic flux density at the predetermined center of the jig; defining a first area of the magnetron based on the measured first magnetic flux density; rotating the magnetron and measuring a plurality of second magnetic flux densities within the first area of the magnetron; deriving a measured second magnetic flux density among the plurality of second magnetic flux densities; comparing the measured second magnetic flux density with a predetermined threshold; and performing an operation based on the comparison.

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Background/Summary

PRIORITY CLAIM AND CROSS-REFERENCE (1) This application is a divisional application of the U.S. non-provisional application Ser. No. 16/430,179 filed on Jun. 3, 2019, entitled “ANALYZING METHOD,” and claimed the benefit of provisional application Ser. 62/771,835 filed on Nov. 27, 2018, entitled “A METHOD OF ANALYZING A MANUFACTURING APPARATUS,” the disclosure of which is hereby incorporated by reference in its entirety.

BACKGROUND

(1) With the advancement of electronic technology, semiconductor device is becoming increasingly smaller in size while having greater functionality and greater amounts of integrated circuitry. Due to the miniaturized scale of the semiconductor device, a number of semiconductor components are assembled on the semiconductor device. Furthermore, numerous manufacturing operations are implemented within such a small semiconductor device.

(2) Prior to fabrication of the semiconductor device, calibration of a manufacturing apparatus is

performed. Components of the manufacturing apparatus have to undergo tuning or adjustment for the purpose of fabrication stability and repeatability. The manufacturing operations can be repeatedly implemented on each of the semiconductor devices, and semiconductor components can be accurately assembled on the semiconductor device. However, the calibration of the manufacturing apparatus is dependent on accuracy of data associated with physical properties of each component of the manufacturing apparatus (i.e. dimension, coefficient of thermal expansion, life span, hardness, etc.). As such, stability of the manufacturing apparatus and manufacturing repeatability of the semiconductor device may encounter challenges.
(3) Therefore, there is a continuous need to modify and improve the fabrication of the semiconductor device and the manufacturing apparatus for fabricating the semiconductor device.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) Aspects of the present disclosure are best understood from the following detailed description when read with the accompanying figures. It is emphasized that, in accordance with the standard practice in the industry, various features are not drawn to scale. In fact, the dimensions of the various features may be arbitrarily increased or reduced for clarity of discussion.
(2) FIG. **1** is a schematic cross sectional view of a manufacturing apparatus in accordance with some embodiments of the present disclosure.
(3) FIG. **2** is a flow diagram of a method of analyzing a manufacturing apparatus in accordance with some embodiments of the present disclosure.
(4) FIGS. **3-4** are schematic cross sectional views of analyzing a manufacturing apparatus by a method of FIG. **2** in accordance with some embodiments of the present disclosure.
(5) FIG. **5** is a flow diagram of a method of analyzing a manufacturing apparatus in accordance with some embodiments of the present disclosure.
(6) FIG. **6** is a schematic cross sectional view of analyzing a manufacturing apparatus by a method of FIG. **5** in accordance with some embodiments of the present disclosure.
DETAILED DESCRIPTION OF THE DISCLOSURE
(7) The following disclosure provides many different embodiments, or examples, for implementing different features of the provided subject matter. Specific examples of components and arrangements are described below to simplify the present disclosure. These are, of course, merely examples and are not intended to be limiting. For example, the formation of a first feature over or on a second feature in the description that follows may include embodiments in which the first and second features are formed in direct contact, and may also include embodiments in which additional features may be formed between the first and second features, such that the first and second features may not be in direct contact. In addition, the present disclosure may repeat reference numerals and/or letters in the various examples. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various embodiments and/or configurations discussed.
(8) Further, spatially relative terms, such as “beneath,” “below,” “lower,” “above,” “upper” and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. The spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. The apparatus may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein may likewise be interpreted accordingly.
(9) A semiconductor structure is manufactured by a number of operations. The operations are performed by manufacturing apparatuses. Calibration of the manufacturing apparatus is performed

before the performance of the operations. The calibration is performed based on the data associated with physical properties of each component of the manufacturing apparatus (i.e. dimension, coefficient of thermal expansion, life span, hardness, etc.). However, measurement of those physical properties may not be accurate. Those data may have some deviations. For example, profiles of a magnetron and a sputtering target in a sputter may not be accurately derived, and thus sputtering over the semiconductor structure may not be implemented repeatedly and stably.

(10) In the present disclosure, a method of analyzing a manufacturing apparatus is disclosed. The method includes providing a jig including a predetermined center and a magnetron installed on the jig; rotating the magnetron and obtaining a measured first magnetic flux density at the predetermined center of the jig; defining a first area of the magnetron based on the measured first magnetic flux density; rotating the magnetron and measuring a plurality of second magnetic flux densities within the first area of the magnetron; deriving a measured second magnetic flux density among the plurality of second magnetic flux densities; comparing the measured second magnetic flux density with a predetermined threshold, and performing an operation based on the comparison. A position of a center of the magnetron used in a sputter can be accurately obtained based on the method.

(11) In the present disclosure, another method of analyzing a manufacturing apparatus is disclosed. The method includes providing a jig including a predetermined center and a sputtering target installed on the jig; defining a first area of the jig around the predetermined center, measuring a plurality of first depths within the first area of the jig; deriving a maximum first depth among the plurality of first depths; defining a second area of the jig around the maximum first depth of the jig; measuring a plurality of second depths within the second area of the jig; deriving a maximum second depth among the plurality of second depths; comparing the maximum first depth with the maximum second depth; and performing an operation based on the comparison. A position of a center of the sputtering target used in a sputter can be accurately obtained based on the method.

(12) Therefore, repeatability and stability of manufacturing of the semiconductor structure by the sputter can be improved. A reliability of the semiconductor structure can also be improved.

(13) FIG. **1** is a schematic view of an apparatus **100** in accordance with various embodiments of the present disclosure. In some embodiments, the apparatus **100** includes a magnetron **101**, a sputtering target **102**, a stage **103** and a substrate **104**. In some embodiments, the apparatus **100** is configured to perform sputtering operations. In some embodiments, the apparatus **100** is configured to perform physical vapor deposition (PVD) operations. In some embodiments, the apparatus **100** is configured to perform deposition of a coating **102***a* over the substrate **104**. In some embodiments, the apparatus **100** is a sputter.

(14) In some embodiments, the magnetron **101** is provided over the sputtering target **102**. In some embodiments, the magnetron **101** is disposed on the sputtering target **102**. In some embodiments, the magnetron **101** is arranged in a close proximity to the sputtering target **102**. In some embodiments, the magnetron **101** is physically contacted with the sputtering target **102** or spaced from the sputtering target **102**. In some embodiments, the magnetron **101** is configured to provide a magnetic field. In some embodiments, the magnetron **101** is configured to provide a magnetic field around the sputtering target **102**.

(15) In some embodiments, the magnetron **101** is a permanent magnet or rotatable magnet. In some embodiments, the magnetron **101** is rotatable about its center. In some embodiments, the magnetron **101** is electrically connected to a voltage. In some embodiments, the magnetron **101** is in circular, elliptical, annular, spiral, irregular or any other suitable shapes.

(16) In some embodiments, the sputtering target **102** is disposed adjacent to the magnetron **101**. In some embodiments, at least a portion of the sputtering target **102** is consumed upon the sputtering operations. In some embodiments, an atom of the sputtering target **102** is knocked out by an energized ion upon the sputtering operations. In some embodiments, the sputtering target **102** is a piece of material from which the coating **102***a* over the substrate **104** is to be formed.

(17) In some embodiments, the sputtering target **102** includes conductive or insulating material. In some embodiments, the sputtering target **102** includes a precursor material which can react with a gas to form a molecule from which the coating **102***a* deposited over the substrate **104** is made. In some embodiments, the sputtering target **102** includes copper, copper oxide, silicon, aluminum, manganese, aluminum nitride, aluminum oxide, etc. In some embodiments, the sputtering target **102** is electrically connected to a cathode. In some embodiments, the sputtering target **102** is in a circular shape.
(18) In some embodiments, the stage **103** is configured to hold the substrate **104**. In some embodiments, the substrate **104** is attached to the stage **103**. In some embodiments, the stage **103** is rotatable about its center.
(19) In some embodiments, the substrate **104** is disposed on the stage **103**. In some embodiments, the substrate **104** is rotatable about its center by the stage **103**. In some embodiments, the substrate **104** is a wafer. In some embodiments, the substrate **104** includes a circuitry thereover. In some embodiments, the substrate **104** includes electrical components and conductive lines connecting the electrical components. In some embodiments, the substrate **104** is electrically connected to an anode.
(20) Upon the sputtering operations, the magnetron **101** provides a magnetic field around the target **102**, and the magnetic field generated from the magnetron energizes ions (such as argon ions or the like) and guides the energized ions to knock out atoms of the target **102**. The atoms of the target **102** are then displaced towards the substrate **104**, and as a result the atoms of the target **102** are sputtered over a surface of the substrate **104** to form the coating **102***a* on the surface of the substrate **104**.
(21) In the present disclosure, a method of analyzing a manufacturing apparatus is disclosed. In some embodiments, a component of the manufacturing apparatus is analyzed by a method **200**. The method **200** includes a number of operations and the description and illustration are not deemed as a limitation as the sequence of the operations. FIG. **2** is an embodiment of the method **200** of analyzing the component of the manufacturing apparatus. The method **200** includes a number of operations (**201**, **202**, **203**, **204**, **205**, **206** and **207**). In some embodiments, the method **200** can be automatically performed. In some embodiments, the method **200** is implemented in automation. In some embodiments, all components of the manufacturing apparatus involved in the method **200** are integrated and controlled by programming in order to automatically perform a measurement of a center of the magnetron **101**.
(22) In operation **201**, a first jig **105** and a magnetron **101** are provided as shown in FIG. **3**. In some embodiments, the first jig **105** is configured to hold the magnetron **101**. In some embodiments, the first jig **105** includes a first recess **105***a* for receiving a portion of the magnetron **101**, such that the magnetron **101** can be temporarily fixed on the first jig **105**.
(23) In some embodiments, the first jig **105** includes a first predetermined center **105***b*. In some embodiments, the first predetermined center **105***b* is a rough or estimated center of the first jig **105** and therefore is deviated from an exact center of the first jig **105**. In some embodiments, the first predetermined center **105***b* is substantially equivalent to the exact center of the first jig **105**. In some embodiments, a probe is displaced towards the first predetermined center **105***b* and above the magnetron **101** for subsequent measurement.
(24) In operation **202**, the magnetron **101** is rotated and a measured first magnetic flux density at the first predetermined center **105***b* of the first jig **105** is obtained. In some embodiments, the magnetron **101** is rotated about the first predetermined center **105***b*. In some embodiments, the magnetron **101** is rotated as an arrow A shown in FIG. **4**. In some embodiments, the first magnetic flux density at the first predetermined center **105***b* is measured by a probe. In some embodiments, several first magnetic flux densities are measured upon the rotation of the magnetron **101**, and a first maximum magnetic flux density and a first minimum magnetic flux density are obtained among the first magnetic flux densities. In some embodiments, the measured first magnetic flux

density is a difference between the first maximum magnetic flux density and the first minimum magnetic flux density. In some embodiments, the measured first magnetic flux density is a standard deviation derived from the first magnetic flux densities, the first maximum magnetic flux density and the first minimum magnetic flux density. In some embodiments, the measured first magnetic flux density is recorded.

(25) In operation **203**, a first area of the magnetron **101** based on the measured first magnetic flux density is defined. In some embodiments, the first area of the magnetron **101** is defined around the first predetermined center **105***b*. In some embodiments, the first area of the magnetron **101** is defined by outward expansion from the first predetermined center **105***b*. In some embodiments, a dimension or size of the first area of the magnetron **101** is based on a magnitude of the measured first magnetic flux density obtained in the operation **202**. In some embodiments, the dimension of the first area of the magnetron **101** is substantially proportional to the magnitude of the measured first magnetic flux density. For example, a relatively large area of the magnetron **101** (e.g. 5 cm×5 cm) is defined if a relatively large measured first magnetic flux density (e.g. 50 Gauss or above) is obtained.

(26) In operation **204**, the magnetron **101** is rotated and several second magnetic flux densities within the first area of the magnetron **101** are measured. In some embodiments, the magnetron **101** is rotated about the first predetermined center **105***b*. In some embodiments, the second magnetic flux densities within the first area of the magnetron **101** are measured by a probe. The second magnetic flux densities are obtained by probing several points within the first area of the magnetron **101**. In some embodiments, the second magnetic flux densities are recorded.

(27) In operation **205**, a measured second magnetic flux density is derived. In some embodiments, several second magnetic flux densities are measured upon the rotation of the magnetron **101**, and a second maximum magnetic flux density and a second minimum magnetic flux density are obtained among the second magnetic flux densities. In some embodiments, the measured second magnetic flux density is a difference between the second maximum magnetic flux density and the second minimum magnetic flux density. In some embodiments, the measured second magnetic flux density is a standard deviation derived from the second magnetic flux densities, the second maximum magnetic flux density and the second minimum magnetic flux density. In some embodiments, the measured second magnetic flux density is recorded.

(28) In operation **206**, the measured second magnetic flux density is compared with a predetermined threshold. In some embodiments, the predetermined threshold is a magnitude of a magnetic flux density such as zero Gauss, 0.3 Gauss, 1 Gauss, 2 Gauss, 5 Gauss, 10 Gauss, 20 Gauss, etc. In some embodiments, the predetermined threshold can be automatically or manually defined.

(29) In operation **207**, an operation is performed based on the comparison (the operation **206**). In some embodiments, if the measured second magnetic flux density is equal to or substantially less than the predetermined threshold according to the comparison (the operation **206**), a position of the magnetron **101** having the minimum second magnetic flux density is defined as a center of the magnetron **101**. For example, if the measured second magnetic flux density is equal to or less than 0.2 Gauss, a position of the magnetron **101** having the minimum second magnetic flux density is defined as a center of the magnetron **101**. In some embodiments, the center of the magnetron **101** having the minimum second magnetic flux density is an exact center of the magnetron **101**. In some embodiments, the center of the magnetron **101** is vertically aligned with or deviated from the first predetermined center **105***b* of the jig **105**.

(30) In some embodiments, the position of the magnetron **101** defined as the center of the magnetron **101** is derived. In some embodiments, a coordinate of the position of the center of the magnetron **101** is obtained and recorded. In some embodiments, the probe is moved to the position of the center of the magnetron **101** after obtaining the coordinate of the position of the center of the magnetron **101**.

(31) In some embodiments, if the measured second magnetic flux density is substantially greater than the predetermined threshold according to the comparison (the operation **206**), the operations **203**, **204**, **205** and **206** are repeated. In some embodiments, after the comparison (the operation **206**), a second area of the magnetron **101** based on the measured second magnetic flux density obtained in the operation **205** is defined. In some embodiments, the second area of the magnetron **101** is substantially larger than the first area of the magnetron **101** defined in the operation **203**.
(32) In some embodiments, the second area of the magnetron **101** is defined by expanding the first area of the magnetron **101**. In some embodiments, a dimension or size of the second area of the magnetron **101** is based on a magnitude of the measured second magnetic flux density. In some embodiments, the dimension of the second area of the magnetron **101** is substantially proportional to the magnitude of the measured second magnetic flux density. In some embodiments, the first area of the magnetron **101** is expanded or shrunken to the second area of the magnetron **101**. In some embodiments, the first area of the magnetron **101** is same as the second area of the magnetron **101**. For example, if the difference between the measured second magnetic flux density and the predetermined threshold is relatively large (e.g. 50 Gauss or above), expansion of the first area becomes larger (e.g. expanding from the first area with 5 cm×5 cm to the second area with 10 cm×10 cm). For example, if the difference between the measured second magnetic flux density and the predetermined threshold is relatively small (e.g. less than 10 Gauss), expansion of the first area becomes smaller (e.g. expanding from the first area with 5 cm×5 cm to the second area with 7 cm×7 cm). In some embodiments, the definition of the second area of the magnetron **101** is similar to the operation **203**.
(33) In some embodiments, after defining the second area of the magnetron **101**, the magnetron **101** is rotated and several third magnetic flux densities within the second area of the magnetron **101** are measured. In some embodiments, the magnetron **101** is rotated about the first predetermined center **105***b*. In some embodiments, the third magnetic flux densities within the second area of the magnetron **101** are measured by a probe. The third magnetic flux densities are obtained by probing several points within the second area of the magnetron **101**. In some embodiments, the third magnetic flux densities are recorded. In some embodiments, the measurement of the third magnetic flux densities is similar to the operation **204**.
(34) In some embodiments, after the measurement of the third magnetic flux densities, a measured third magnetic flux density is obtained. In some embodiments, several third magnetic flux densities are measured upon the rotation of the magnetron **101**, and a third maximum magnetic flux density and a third minimum magnetic flux density are obtained among the third magnetic flux densities. In some embodiments, the measured third magnetic flux density is a difference between the third maximum magnetic flux density and the third minimum magnetic flux density. In some embodiments, the measured third magnetic flux density is a standard deviation derived from the third magnetic flux densities, the third maximum magnetic flux density and the third minimum magnetic flux density. In some embodiments, the deriving of the measured third magnetic flux density is similar to the operation **205**. In some embodiments, the measured third magnetic flux density is recorded.
(35) In some embodiments, after deriving the measured third magnetic flux density, the measured third magnetic flux density is compared with the predetermined threshold. In some embodiments, the comparison is similar to the operation **206**.
(36) In some embodiments, if the measured third magnetic flux density is equal to or substantially less than the predetermined threshold, a position of the magnetron **101** having the minimum third magnetic flux density is defined as a center of the magnetron **101**. In some embodiments, the center of the magnetron **101** having the minimum third magnetic flux density is an exact center of the magnetron **101**. In some embodiments, the center of the magnetron **101** is vertically aligned with or deviated from the first predetermined center **105***b* of the jig **105**.
(37) In some embodiments, the position of the magnetron **101** defined as the center of the

magnetron **101** is derived. In some embodiments, a coordinate of the position of the center of the magnetron **101** is obtained and recorded. In some embodiments, the probe is moved to the position of the center of the magnetron **101** after obtaining the coordinate of the position of the center of the magnetron **101**.

(38) In some embodiments, if the measured third magnetic flux density is substantially greater than the predetermined threshold, the operations **203**, **204**, **205** and **206** are repeated again. The operations are terminated when an exact center of the magnetron **101** was found.

(39) In the present disclosure, a method of analyzing a manufacturing apparatus is disclosed. In some embodiments, a component of the manufacturing apparatus is analyzed by a method **300**. The method **300** includes a number of operations and the description and illustration are not deemed as a limitation as the sequence of the operations. FIG. **5** is an embodiment of the method **300** of analyzing the component of the manufacturing apparatus. The method **300** includes a number of operations (**301**, **302**, **303**, **304**, **305**, **306**, **307**, **308** and **309**). In some embodiments, the method **300** can be automatically performed. In some embodiments, the method **300** is implemented in automation. In some embodiments, all components of the manufacturing apparatus involved in the method **300** are integrated and controlled by programming in order to automatically perform a measurement of a center of the sputtering target **102**.

(40) In operation **301**, a second jig **106** and a sputtering target **102** are provided as shown in FIG. **6**. In some embodiments, the second jig **106** is configured to hold the sputtering target **102**. In some embodiments, the second jig **106** includes a second recess **106***a* for receiving a portion of the sputtering target **102**, such that the sputtering target can be temporarily fixed on the second jig **106**.

(41) In some embodiments, the second jig **106** includes a second predetermined center **106***b*. In some embodiments, the second predetermined center **106***b* is a rough center of the second jig **106** and therefore is deviated from an exact center of the second jig **106**. In some embodiments, the second predetermined center **106***b* is substantially equivalent to the exact center of the second jig **106**. In some embodiments, a probe is displaced towards the second predetermined center **106***b* for subsequent measurement.

(42) In operation **302**, a first area of the second jig **106** is defined. In some embodiments, the first area of the second jig **106** is defined around the second predetermined center **106***b*. In some embodiments, the first area of the second jig **106** is defined by outward expansion from the second predetermined center **106***b*.

(43) In operation **303**, several first depths within the first area of the second jig **106** are measured. In some embodiments, the first depths are measured by a probe. The first depths are obtained by probing several points within the first area of the second jig **106**. In some embodiments, the first depths are recorded.

(44) In operation **304**, a maximum first depth among the first depths is derived. In some embodiments, the maximum first depth is determined after the measurement of the first depths. In some embodiments, a position of the second jig **106** having the maximum first depth is also derived. In some embodiments, the maximum first depth is recorded.

(45) In operation **305**, a second area of the second jig **106** is defined. In some embodiments, the second area of the second jig **106** is defined around the maximum first depth of the second jig **106**. In some embodiments, the first area of the second jig **106** is substantially greater than, smaller than or equal to the second area of the second jig **106**. In some embodiments, the second area of the jig **106** is defined by contracting the first area of the second jig **106**. In some embodiments, the first area and the second area of the second jig **106** are at least partially overlapped with each other. In some embodiments, expansion or shrinkage of the first area to the second area is based on a magnitude of the maximum first depth.

(46) In operation **306**, several second depths within the second area of the second jig **106** are measured. In some embodiments, the second depths are measured by a probe. The second depths are obtained by probing several points within the second area of the second jig **106**. In some

embodiments, the second depths are recorded.
(47) In operation **307**, a maximum second depth among the second depths is derived. In some embodiments, the maximum second depth is determined after the measurement of the second depths. In some embodiments, a position of the second jig **106** having the maximum second depth is also derived. In some embodiments, the maximum second depth is recorded.
(48) In operation **308**, the maximum first depth is compared with the maximum second depth. In some embodiments, the comparison can determine if a maximum depth of the second jig **106** was found.
(49) In operation **309**, an operation is performed based on the comparison (the operation **308**). In some embodiments, if the maximum first depth is substantially greater than the maximum second depth according to the comparison (the operation **308**), a position of the second jig **106** having the maximum first depth is defined as a center **106***c* of the second jig **106**. In some embodiments, the center **106***c* of the second jig **106** having the maximum first depth is an exact center of the second jig **106**.
(50) In some embodiments, a center of the sputtering target **102** can be determined based on the center **106***c* of the second jig **106** having the maximum first depth. The center of the sputtering target **102** is vertically aligned with the center **106***c* of the second jig **106**. In some embodiments, a position of the second jig **106** having the maximum first depth is recorded. In some embodiments, a coordinate of the position of the second jig **106** is obtained and recorded. In some embodiments, a position of the center of the sputtering target **102** is vertically aligned with the position of the second jig **106**. In some embodiments, a coordinate of the position of the center of the sputtering target **102** is obtained and recorded.
(51) In some embodiments, if the maximum first depth is substantially less than the maximum second depth according to the comparison (the operation **308**), the operations **305**, **306**, **307** and **308** are repeated. In some embodiments, after the comparison (the operation **308**), a third area of the second jig **106** is defined. In some embodiments, the third area of the second jig **106** is defined around the maximum second depth of the second jig **106**. In some embodiments, the first area of the second jig **106** and the second area of the second jig **106** are substantially the same as each other. In some embodiments, the second area of the second jig **106** is substantially larger than the first area of the second jig **106**. In some embodiments, the definition of the third area of the second jig **106** is similar to the operation **305**.
(52) In some embodiments, after defining the third area of the second jig **106**, several third depths within the third area of the second jig **106** are measured. In some embodiments, the third depths are measured by a probe. The third depths are obtained by probing several points within the third area of the second jig **106**. In some embodiments, the third depths are recorded. In some embodiments, the measurement of the third depths is similar to the operation **306**.
(53) In some embodiments, after the measurement of the third depths, a maximum third depth among the third depths is derived. In some embodiments, the maximum third depth is determined after the measurement of the third depths. In some embodiments, a position of the second jig **106** having the maximum third depth is also derived. In some embodiments, the maximum third depth is recorded. In some embodiments, the deriving of the maximum third depth is similar to the operation **307**.
(54) In some embodiments, after deriving the maximum third depth, the maximum third depth is compared with the maximum second depth. In some embodiments, the comparison can determine if a maximum depth of the second jig **106** was found. In some embodiments, the comparison is similar to the operation **308**.
(55) In some embodiments, if the maximum third depth is substantially less than the maximum second depth according to the comparison, a position of the second jig **106** having the maximum second depth is defined as a center **106***c* of the second jig **106**. In some embodiments, the center **106***c* of the second jig **106** having the maximum second depth is an exact center of the second jig

106.

(56) In some embodiments, a center of the sputtering target **102** can be determined based on the center **106***c* of the second jig **106** having the maximum second depth. The center of the sputtering target **102** is vertically aligned with the center **106***c* of the second jig **106**. In some embodiments, a position of the second jig **106** having the maximum second depth is recorded. In some embodiments, a coordinate of the position of the second jig **106** is obtained and recorded. In some embodiments, a position of the center of the sputtering target **102** is vertically aligned with the position of the second jig **106**. In some embodiments, a coordinate of the position of the center of the sputtering target **102** is obtained and recorded.

(57) In some embodiments, if the maximum third depth is substantially greater than the maximum second depth according to the comparison, the operations **305**, **306**, **307** and **308** are repeated again. In some embodiments, the operations are terminated if a maximum depth of the second jig **106** was found.

(58) In some embodiments, a method includes providing a jig including a predetermined center and a magnetron installed on the jig; rotating the magnetron and obtaining a measured first magnetic flux density at the predetermined center of the jig; defining a first area of the magnetron based on the measured first magnetic flux density; rotating the magnetron and measuring a plurality of second magnetic flux densities within the first area of the magnetron; deriving a measured second magnetic flux density among the plurality of second magnetic flux densities; comparing the measured second magnetic flux density with a predetermined threshold; and performing an operation based on the comparison.

(59) In some embodiments, the performance of the operation includes defining a center of the magnetron having the minimum second magnetic flux density; deriving a position of the center of the magnetron; moving a probe to the position of the center of the magnetron. In some embodiments, the measured second magnetic flux density is equal to or substantially less than the predetermined threshold. In some embodiments, the center of the magnetron is vertically aligned with or deviated from the predetermined center of the jig. In some embodiments, a dimension of the first area of the magnetron is substantially proportional to a magnitude of the measured first magnetic flux density.

(60) In some embodiments, the performance of the operation includes defining a second area of the magnetron based on the measured second magnetic flux density; rotating the magnetron and measuring a plurality of third magnetic flux densities within the second area of the magnetron; deriving a measured third magnetic flux density among the plurality of third magnetic flux densities; comparing the measured third magnetic flux density with the predetermined threshold. In some embodiments, the performance of the operation further includes defining a center of the magnetron having the minimum third magnetic flux density; deriving a position of the center of the magnetron; moving a probe to the position of the center of the magnetron.

(61) In some embodiments, the measured third magnetic flux density is equal to or substantially less than the predetermined threshold. In some embodiments, the center of the magnetron is vertically aligned with or deviated from the predetermined center of the jig. In some embodiments, a dimension of the second area of the magnetron is substantially proportional to a magnitude of the measured second magnetic flux density. In some embodiments, the second area of the magnetron is substantially larger than, smaller than or equal to the first area of the magnetron.

(62) In some embodiments, a method includes providing a jig including a predetermined center and a sputtering target installed on the jig; defining a first area of the jig around the predetermined center, measuring a plurality of first depths within the first area of the jig; deriving a maximum first depth among the plurality of first depths; defining a second area of the jig around the maximum first depth of the jig; measuring a plurality of second depths within the second area of the jig; deriving a maximum second depth among the plurality of second depths; comparing the maximum first depth with the maximum second depth; and performing an operation based on the comparison.

(63) In some embodiments, the first area of the jig is substantially greater than the second area of the jig. In some embodiments, the maximum first depth is substantially greater than the maximum second depth. In some embodiments, the performance of the operation includes recording a position of the jig having the maximum first depth; defining a center of the sputtering target vertically aligned with the position of the jig having the maximum first depth. In some embodiments, the maximum first depth is substantially less than the maximum second depth.
(64) In some embodiments, the performance of the operation includes defining a third area of the jig around the maximum second depth of the jig; measuring a plurality of third depths within the third area of the jig; deriving a maximum third depth among the plurality of third depths; comparing the maximum third depth with the maximum second depth; recording a position of the jig having the maximum second depth; defining a center of the sputtering target vertically aligned with the position of the jig having the maximum second depth. In some embodiments, the maximum third depth is substantially less than the maximum second depth.
(65) In some embodiments, a method includes providing a magnetron having an estimated center, rotating the magnetron and obtaining a measured first magnetic flux density at the estimated center; defining an area of the magnetron around the estimated center, rotating the magnetron and measuring a plurality of second magnetic flux densities within the area of the magnetron; deriving a measured second magnetic flux density among the plurality of second magnetic flux densities; comparing the measured second magnetic flux density with a predetermined threshold; and defining a center of the magnetron based on the comparison.
(66) In some embodiments, the method further includes expanding the area of the magnetron; rotating the magnetron and measuring a plurality of third magnetic flux densities within the expanded area of the magnetron; deriving a measured third magnetic flux density among the plurality of third magnetic flux densities; comparing the measured third magnetic flux density with the predetermined threshold.
(67) The foregoing outlines features of several embodiments so that those skilled in the art may better understand the aspects of the present disclosure. Those skilled in the art should appreciate that they may readily use the present disclosure as a basis for designing or modifying other processes and structures for carrying out the same purposes and/or achieving the same advantages of the embodiments introduced herein. Those skilled in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the present disclosure, and that they may make various changes, substitutions, and alterations herein without departing from the spirit and scope of the present disclosure.

Claims

1. A method, comprising: providing a jig having a recess and a predetermined center within the recess; defining a first area of the jig around the predetermined center by outward expansion from the predetermined center in a first distance; measuring a plurality of first depths of the jig within the first area of the jig by a probe; deriving a maximum first depth among the plurality of first depths; defining a second area of the jig around a first position of the jig having the maximum first depth of the jig by outward expansion from the first position in a second distance; measuring a plurality of second depths of the jig within the second area of the jig by the probe; deriving a maximum second depth among the plurality of second depths; comparing the maximum second depth with the maximum first depth; and performing an operation if the maximum first depth is substantially greater than or equal to the maximum second depth, wherein the operation includes defining the first position of the jig having the maximum first depth of the jig as an exact center of the jig.
2. The method of claim 1, wherein the predetermined center is deviated from the exact center of the jig.

3. The method of claim 1, wherein the second area of the jig is substantially greater than, less than or equal to the first area of the jig.
4. The method of claim 1, wherein the second distance is substantially greater than, less than or equal to the first distance.
5. The method of claim 1, wherein the operation includes recording the first position of the jig having the maximum first depth of the jig.
6. The method of claim 1, wherein the operation includes installing a sputtering target on the jig.
7. The method of claim 6, wherein a center of the sputtering target is vertically aligned with the exact center of the jig.
8. The method of claim 1, wherein the first area of the jig and the second area of the jig are disposed within the recess.
9. The method of claim 1, wherein the first position of the jig is disposed within the recess.
10. A method, comprising: providing a jig having a recess and a predetermined center within the recess; defining a first area of the jig around the predetermined center by outward expansion from the predetermined center in a first distance; measuring a plurality of first depths of the jig within the first area of the jig by a probe; deriving a maximum first depth among the plurality of first depths; defining a second area of the jig around a first position of the jig having the maximum first depth of the jig by outward expansion from the first position in a second distance; measuring a plurality of second depths of the jig within the second area of the jig by the probe; deriving a maximum second depth among the plurality of second depths; comparing the maximum second depth with the maximum first depth; and performing an operation if the maximum first depth is substantially less than the maximum second depth, wherein the operation includes defining a third area of the jig around a second position of the jig having the maximum second depth of the jig by outward expansion from the second position in a third distance.
11. The method of claim 10, wherein the third distance is proportional to a difference between the maximum second depth and the maximum first depth.
12. The method of claim 10, wherein the operation includes: measuring a plurality of third depths of the jig within the third area of the jig by the probe; deriving a maximum third depth among the plurality of third depths; comparing the maximum third depth with the maximum second depth.
13. The method of claim 12, further comprising defining the second position of the jig having the maximum second depth of the jig as an exact center of the jig, if the maximum second depth is substantially greater than or equal to the maximum third depth.
14. The method of claim 13, further comprising installing a sputtering target on the jig.
15. The method of claim 14, wherein a center of the sputtering target is vertically aligned with the exact center of the jig.
16. The method of claim 12, further comprising, if the maximum second depth is substantially less than the maximum third depth: measuring a plurality of fourth depths of the jig within the fourth area of the jig by the probe; deriving a maximum fourth depth among the plurality of fourth depths; comparing the maximum fourth depth with the maximum third depth.
17. The method of claim 16, further comprising defining the third position of the jig having the maximum third depth of the jig as an exact center of the jig, if the maximum third depth is substantially greater than or equal to the maximum fourth depth.
18. The method of claim 16, further comprising, if the maximum third depth is substantially less than the maximum fourth depth: measuring a plurality of fifth depths of the jig within the fifth area of the jig by the probe; deriving a maximum fifth depth among the plurality of fifth depths; comparing the maximum fifth depth with the maximum fourth depth.
19. A method, comprising: providing a jig having a recess and a predetermined center within the recess; defining an area of the jig around the predetermined center by outward expansion from the predetermined center in a distance; measuring a plurality of depths of the jig within the area of the jig by a probe; deriving a maximum depth among the plurality of depths; defining a position of the

jig having the maximum depth of the jig as an exact center of the jig; vertically aligning a center of a sputtering target with the position of the jig; and installing the sputtering target on the jig after the vertical alignment.

20. The method of claim 19, wherein the predetermined center is derived from or substantially equivalent to the position of the jig.