OIMG**2** may be converted into the third boundary BD**3'**, a fourth boundary BD**4'**, the second line IL**2'**, a protrusion **205***a*, a first layer **210***a* and a layer **230***a* in the first image IMG**21**, respectively.

[0134] The fin structure **220** may be represented in the first image IMG**21** based on second rectangular coordinates with the horizontal axis direction X and the second vertical axis direction Y'. The first vertical axis direction Y for representing the original image OIMG**2** may be different from the second vertical axis direction Y' for representing the first image IMG**21**.

[0135] A second image is generated by performing a filtering operation on the first image (step S**400**). As described above with reference to FIG. **9**, the first image may be divided into a plurality of subregions, an averaging operation may be performed on each of the plurality of subregions, noise may be removed from the first image, and thus the second image may be obtained. In addition, the other of two boundaries of the first layer is extracted from the second image (step S**500**), and the thickness of the first layer is calculated based on the second image that includes the linearly rearranged boundary and the other extracted boundary (step S**600**).

[0136] For example, as illustrated in FIG. **16**, the first image IMG**21** may be divided into the plurality of subregions. A first subregion SA**2** among the plurality of subregions may have a rectangular shape. For example, the first subregion SA**2** may have a first side that extends in the second vertical axis direction Y' and a second side that extends in the horizontal axis direction X. The second side may be shorter than the first side. The first subregion SA**2** may be averaged by calculating an average grayscale of partial images (e.g., pixel images) in the first subregion SA**2**, and by changing all of grayscales of the partial images in the first subregion SA**2** into the average grayscale. In addition, the noise may be selectively removed from the first image IMG**21**.

[0137] As illustrated in FIG. **17**, the second image IMG**22** may be finally obtained. By converting the first image IMG**21** into the second image IMG**22**, the third boundary BD**3'**, the fourth boundary BD**3'**, the second line IL**2'**, the protrusion **205***a*, the first layer **210***a* and the layer **230***a* in the first image IMG**21** may be converted into a fifth boundary BD**3"**, a sixth boundary BD**4"**, a third line IL**2"**, a protrusion **205***b*, a first layer **210***b* and a layer **230***b* in the second image IMG**22**, respectively. In the second image IMG**22**, thicknesses of the first layer **210***b* may be calculated by measuring a distance d**21** between a first point on the fifth boundary BD**3"** and a first point on the sixth boundary BD**4"**, by measuring a distance d**22** between a second point on the fifth boundary BD**3"** and a second point on the sixth boundary BD**4"**, and by measuring a distance d**2***n* between a n-th point on the fifth boundary BD**3"** and a n-th point on the sixth boundary BD**4"**.

[0138] In some example embodiments, similar to the first image IMG**21**, the fin structure **220** may be represented in the second image IMG**22** based on the second rectangular coordinates with the horizontal axis direction X and the second vertical axis direction Y'.

[0139] FIG. **18** is a flow chart illustrating a method of measuring a thickness according to some example embodiments. FIGS. **19**, **20** and **21** are diagrams for describing the method of measuring the thickness according to some example embodiments. FIGS. **19**, **20** and **21** illustrate images associated with a hole structure that is similar to the hole structure **160** in FIG. **2**. FIG. **19** illustrates an example of an original image OIMG**3** representing the hole structure in a plan view. FIG. **20** illustrates an example of a first image IMG**31** that is converted from the original image OIMG**3** of FIG. **19**. FIG. **21** illustrates an example of a second image IMG**32** that is generated based on the first image IMG**31** of FIG. **20**.

[0140] Referring to FIGS. **18**, **19**, **20** and **21**, in the method of measuring the thickness according to some example embodiments, an original image including image information of a structure having a plurality of layers is obtained (step S**1100**). As illustrated in FIG. **19**, in the original image OIMG**3**, the hole structure may include a first layer **310**, a second layer **320** inside the first layer **310**, a third layer **330** inside the second layer **320**, and a filling layer pattern **340** inside the third layer **330**. A layer **305** may be formed outside the first layer **310**. The hole structure may be represented in the original image OIMG**3** based on rectangular coordinates with a horizontal axis direction X and a vertical axis direction Y.

[0141] The first layer **310** may include a first boundary BDA and a second boundary BDB, the second layer **320** may include the second boundary BDB and a third boundary BDC, and the third layer **330** may include the third boundary BDC and a fourth boundary BDD. As illustrated in FIG. **19**, the first, second and third layers **310**, **320** and **330** may include irregular and/or nonsmooth boundaries BDA, BDB, BDC and BDD. In the original image OIMG**3**, it may be relatively easy to detect the first boundary BDA, and it may be relatively difficult to detect the second, third and fourth boundaries BDB, BDC and BDD.

[0142] One of two boundaries of a first layer among the plurality of layers is extracted from the original image (step S**1200**). The step S**1200** in FIG. **18** may be similar to the step S**200** in FIG. **1**. For example, a plurality of boundary points may be detected from the original image OIMG**3** based on grayscale changes in the original image OIMG**3**, and the plurality of boundary points may be determined as the first boundary BDA.

[0143] The original image is converted into a first image based on the one of two boundaries of the first layer (step S**1300**). The step S**1300** in FIG. **18** may be substantially the same as the step S**300** in FIG. **1**.

[0144] For example, as illustrated in FIGS. **20** and **21**, the plurality of boundary points in the original image OIMG**3** may be mapped into a plurality of axis points in the first image IMG**31**. The plurality of boundary points corresponding to the first boundary BDA may be nonlinearly arranged in the original image OIMG**3**, and the plurality of axis points corresponding to a fifth boundary BDA' may be linearly arranged in the first image IMG**31**. Partial images (e.g., pixel images) in a target region in the original image OIMG**3** may be rearranged into partial images in the first image IMG**31**. By converting the original image OIMG**3** into the first image IMG**31**, the first, second, third and fourth boundaries BDA, BDB, BDC and BDD, the first, second and third layers **310**, **320** and **330** and the filling layer pattern **340** in the original image OIMG**3** may be converted into the fifth, sixth, seventh and eighth boundaries BDA', BDB', BDC' and BDD', first, second and third layers **310***a*, **320***a* and **330***a* and a filling layer pattern **340***a* in the first image IMG**31**, respectively.

[0145] A second image is generated by performing a filtering operation on the first image (step S**1400**). The step