CLAIMS

1. A method for defect classification, comprising:

inputting a to-be-detected image and first position prompt information into a feature extraction network of a defect classification model to obtain an image feature and a position identification feature of the to-be-detected image, wherein the first position prompt information indicates a position of a defect region in the to-be-detected image; and

inputting the image feature and the position identification feature into a fully connected neural network of the defect classification model to obtain a defect classification result, wherein the defect classification result indicates a category to which the defect region in the to-be-detected image belongs,

wherein the defect classification model is implemented by an open-world semi-supervised learning model.

2. The method according to claim 1, wherein the defect classification model further comprises an attention network, and before the inputting the image feature and the position identification feature into a fully connected neural network of the defect classification model to obtain a defect classification result, the method further comprises:

inputting the image feature and the position identification feature into the attention network for feature fusion to obtain a fused feature, and wherein

the inputting the image feature and the position identification feature into a fully connected neural network of the defect classification model to obtain a defect classification result comprises:

inputting the fused feature into the fully connected neural network to obtain the defect classification result.

3. The method according to claim 1, wherein

the first position prompt information comprises: target bounding box prompt information corresponding to a target detection bounding box containing the defect region, and/or mask prompt information corresponding to a mask of the defect region, and/or identification point prompt information corresponding to one or more identification points within the defect region; and

the position identification feature comprises: a target bounding box encoded feature corresponding to the target detection bounding box containing the defect region, and/or a mask encoded feature corresponding to the mask of the defect region, and/or an identification point encoded feature corresponding to the one or more identification points within the defect region.

4. The method according to claim 1, wherein the feature extraction network comprises an image encoding module and a position encoding module, and the inputting a to-be-detected image and first position prompt information into a feature extraction network of a defect classification model to obtain an image feature and a position identification feature of the to-be-detected image comprises:

inputting the to-be-detected image into the image encoding module to obtain the image feature; and

inputting the first position prompt information into the position encoding module to obtain the position identification feature.

5. The method according to claim 4, wherein the first position prompt information comprises: target bounding box prompt information corresponding to a target detection bounding box containing the defect region, and/or mask prompt information corresponding to a mask of the defect region, and/or identification point prompt information corresponding to one or more identification points within the defect region; the position identification feature comprises: a target bounding box encoded feature corresponding to the target detection bounding box containing the defect region, and/or a mask encoded feature corresponding to the mask of the defect region, and/or an identification point encoded feature corresponding to the one or more identification points within the defect region; and the position encoding module comprises: a target bounding box encoder, and/or a mask encoder, and/or an identification point encoder, and wherein

the inputting the first position prompt information into the position encoding module to obtain the position identification feature comprises:

inputting the target bounding box prompt information into the target bounding box encoder to obtain the target bounding box encoded feature; and/or,

inputting the mask prompt information into the mask encoder to obtain the mask encoded feature; and/or,

inputting the identification point prompt information into the identification point encoder to obtain the identification point encoded feature.

6. The method according to claim 4, wherein the image encoding module is trained using an unsupervised training method, and during training the defect classification model, a parameter of the image encoding module is fixed, and a parameter of the position encoding module is trained.

7. The method according to any one of claims 1 to 6, further comprising:

acquiring a sample data set, wherein the sample data set comprises annotated data and unannotated data, the annotated data comprises a plurality of first sample images and respective second position prompt information and respective annotated labels corresponding to the plurality of first sample images, each of the annotated labels indicates a category to which a defect region in the corresponding first sample image belongs, and the unannotated data comprises a plurality of second sample images and respective third position prompt information corresponding to the plurality of second sample images;

performing, based on the sample data set, a round of model training operation, which comprises:

training the defect classification model by using the annotated data to obtain an initially trained defect classification model;

inputting the plurality of second sample images and the third position prompt information corresponding to the plurality of second sample images into the initially trained defect classification model to obtain respective first predicted classification results corresponding to the plurality of second sample images, wherein each of the first predicted classification results indicates a category to which a defect region in the corresponding second sample image belongs;

obtaining, based on the first predicted classification results corresponding to the plurality of second sample images, pseudo labels corresponding to at least a portion of the plurality of second sample images;

inputting the plurality of first sample images and the second position prompt information corresponding to the plurality of first sample images into the initially trained defect classification model to obtain respective second predicted classification results corresponding to the plurality of first sample images, wherein each of the second predicted classification

results indicates a category to which a defect region in the corresponding first sample image belongs;

inputting the at least a portion of the plurality of second sample images and the third position prompt information corresponding to the at least a portion of the plurality of second sample images into the initially trained defect classification model to obtain respective third predicted classification results corresponding to the at least a portion of the plurality of second sample images, wherein each of the third predicted classification results indicates a category to which a defect region in the corresponding second sample image belongs;

calculating a prediction loss based on a difference between the annotated labels corresponding to the plurality of first sample images and the second predicted classification results corresponding to the plurality of first sample images, and a difference between the pseudo labels corresponding to the at least a portion of second sample images and the third predicted classification results corresponding to the at least a portion of second sample images; and

optimizing a parameter in the initially trained defect classification model based on the prediction loss to obtain a trained defect classification model corresponding to the round of model training operation.

8. The method according to claim 7, wherein the to-be-detected image comprises a plurality of first to-be-detected images, and the method further comprises:

after the round of training operation is completed, obtaining a respective fourth predicted classification result that corresponds to each test image of at least one test image and is predicted by the trained defect classification model, wherein the fourth predicted classification result indicates a category to which a defect region in the corresponding test image belongs, and the at least one test image comprises one or more of: at least a portion of the plurality of second sample images, the to-be-detected image, and a new image other than the plurality of second sample images and the to-be-detected image;

outputting the fourth predicted classification result corresponding to the at least one test image; and

performing an operation on the fourth predicted classification result and/or the test image in response to verification information input by a user.

9. The method according to claim 8, wherein the performing an operation on the fourth predicted classification result and/or the test image in response to verification information input by a user comprises one or more of:

for any test image of the at least one test image that is classified into a known category based on the fourth predicted classification result, deleting the test image if the verification information comprises deletion information for the test image, wherein the known category is indicated by the annotated labels in the annotated data;

for any new category indicated in the fourth predicted classification result, deleting, if the verification information comprises deletion information for the new category, the new category from the fourth predicted classification result, wherein the new category is different from the known category;

for any new category indicated in the fourth predicted classification result, merging, if the verification information comprises merge information for the new category, the new category with a known category specified by the merge information into a same category; and

for any new category indicated in the fourth predicted classification result, adding, if the verification information comprises adding information for the new category, the new category and a test image classified into the new category to the annotated data.

10. The method according to any one of claims 1 to 6, wherein the to-be-detected image is a wafer image comprising a wafer, and the defect region is on the wafer.

11. An apparatus for defect classification, comprising:

a first input module, configured to input a to-be-detected image and first position prompt information into a feature extraction network of a defect classification model to obtain an image feature and a position identification feature of the to-be-detected image, wherein the first position prompt information indicates a position of a defect region in the to-be-detected image; and

a second input module, configured to input the image feature and the position identification feature into a fully connected neural network of the defect classification model to obtain a defect classification result, wherein the defect classification result indicates a category to which the defect region in the to-be-detected image belongs,

wherein the defect classification model is implemented by an open-world semi-supervised

learning model.

12. An electronic device, comprising a processor and a memory, wherein the memory stores computer program instructions, and the computer program instructions, when executed by the processor, perform the method for defect classification according to any one of claims 1 to 10.

13. A storage medium storing computer program/instructions, wherein the computer program/instructions, when executed, perform the method for defect classification according to any one of claims 1 to 10.