Claims

1. An ALD reactor system (700), comprising:
a reactor chamber in fluid connection with a fore-line, a vacuum pump and a residual gas analyzer;
control means (702) configured to cause the ALD reactor system to perform the method of claim 12;
at least one precursor source in fluid communication with the reactor chamber via an in-feed part;
first pretreating means arranged to pretreat a substrate by cleaning;
second pretreating means arranged to heat the substrate;
a residual gas analyzer in fluid communication with the reaction chamber, said residual gas analyzer being configured to communicate with the control means (702) and to analyze gas flowing out from the reactor chamber in the fore-line; and
the control means (702) being configured to receive signals from the residual gas analyzer and based on these signals being configured to control at least gas flow and pulsing, whereby whisker formation, electromigration and corrosion on a substrate material to be deposited are reduced;
wherein the fore-line is arranged with heating means for heating the fore-line and with means for varying the flow of the gas flowing out from the reactor chamber.

2. The ALD reactor system (700) of claim 1 comprising at least one further gas inlet configured to be heated separately from other gas inlets to at least temperature of 500°C.

3. The ALD reactor system (700) of claim 2 comprising gas inlets configured to enable pulsing H_2, O_2 or O_3.

4. The ALD reactor system (700) of claim 2 or 3 comprising gas inlets configured to withstand elevated temperatures higher than the temperature of the reaction chamber temperature.

5. The ALD reactor system of any preceding claim 1-4 further comprising a heated gas exhaust fore-line with means for varying the flow of said exhaust gas.

6. The ALD reactor system (700) of claims 1-5 comprising gas inlets configured to enable gas pulse with a temperature difference of at least 100°C, compared to the reactor space.

7. The ALD reactor system (700) of claim 6 wherein the at least one further gas inlet is made of ceramic material or metal, or metal coated with ceramic material, and wherein the further gas inlet comprises heating means for separately heating the further gas inlet.

8. ALD reactor system (700) of any preceding claim 1-7 wherein at least one further gas inlet is configured to be heated in an intermediate space of the reactor.

9. The ALD reactor system of any preceding claim 1-8 configured to reduce whisker formation, electromigration and corrosion on a surface of a substrate material made of metal.

10. The ALD reactor system of claim 9, wherein the said metal is selected from the group consisting of: Zn, Sn, Cd, and Ag.

11. The ALD reactor system of claims 1-10 configured to carry out the method of claims 12-30.

12. A deposition method carried out in a reactor system to reduce metal whisker formation, electromigration and corrosion comprising:

providing a substrate;

pretreating the substrate by cleaning inside the reaction chamber of said ALD reactor;

pretreating the substrate by heating inside the reaction chamber; and
depositing a stack comprising depositing at least a first layer (100) by atomic layer deposition, ALD
wherein depositing comprises a first pulse with a at least one reductive chemical,
during depositing reactive gas is pumped out of a reaction chamber to an heated exhaust fore-line to reach a quantity below 1 part in 1000,
the reactive gases in the exhaust fore-line are analyzed by residual a gas analyzer, and
said residual gas analyzer is connected to control means for varying the flow of the gas flowing out from the reactor chamber.

13. The method of claim 12, wherein the first pulse consists of multiple pulses of the reductive chemical or chemicals followed by an inert gas pulse between them.

14. The method of any of the preceding claims 12-13, wherein filament type metal whiskers formation is decreased or prevented.

15. The method of any of the preceding claims 12-14, wherein the substrate comprises a Printed Circuit Board, PCB; a component; a component housing; or a metal housing.

16. The method of any preceding claim 12-15, wherein depositing the stack further comprises depositing a second layer (200) composed of different sublayers by atomic layer deposition, ALD.

17. The method of claim 16, wherein the second layer (200) comprising at least one elastic sublayer.

18. The method of claim 16 or 17, wherein the second layer (200) comprises at least one organic sublayer or a silicone polymer containing sublayer.

19. The method of any of claims 16 – 18, wherein the second layer 200 comprises at least one sublayer of electrically insulating material.

20. The method of any of claims 16 - 19, wherein at least one sublayer is a hard layer which is any layer comprising metal oxide.

21. The method of any preceding claim 16 - 20, wherein depositing the stack further comprises depositing a third layer (300) by atomic layer deposition, ALD.

22. The method of any preceding claim 16 - 21, wherein pretreating the substrate by preheating comprises preheating with a pulse of heated gas with a temperature above the reaction temperature.

23. The method of any preceding claim 16 – 22, wherein at least one layer comprises at least one reactive chemical with ambient air or moisture.

24. The method of any preceding claim 16 – 23, wherein the thickness of the stack is 1-2000nm, preferably 50-500nm, most preferably 100-200nm.

25. The method of any preceding claim 16 – 24, further comprising varying, stopping or limiting a fore-line exhaust flow.

26. The method of any preceding claim 16 – 25 further comprising providing a further coating on top of the stack with a further coating method.

27. The method of claim26 , wherein the further coating comprises polymer or silicone polymer, such as lacquer, on top of the substrate material deposited by ALD.

28. The method of any preceding claim16 – 27, wherein the cleaning includes applying atomic layer etching ALE pulses onto the substrate material deposited by ALD.

29. The method of any preceding claim 16 – 28, wherein the cleaning includes directing a heat substance selected from the group consisting of H_2 or O_2 or O_3 into the reaction chamber.

30. Use of the ALD reactor system of any preceding claim 1-11 for protecting substrates against metal whisker formation, electromigration and/or corrosion.