

CLAIMS

What is claimed is:

1. A water harvesting system for capturing water from surrounding air, comprising:
an adsorption/desorption unit, comprising:
a plurality of modules, configured such that at least one module operates in adsorption mode concurrently as at least one of the remaining modules operates in desorption mode,
wherein each module comprises at least one structural element,
wherein at least a portion of each structural element supports at least one water capture material,
wherein the at least one water capture material adsorbs water from surrounding air when the module is in adsorption mode, and desorbs water in the form of water vapor when the module is in desorption mode,
a mode-switching structure, configured to concurrently switch at least one module from adsorption mode to desorption mode and at least one module from desorption mode to adsorption mode;
at least one condenser, positioned in proximity to the at least one module in desorption mode, and configured to condense water vapor into liquid water; and
at least one air-circulating unit, configured to draw surrounding air into each module in adsorption mode, thereby assisting adsorption of water by the at least one water capture material from the surrounding air.
2. The system of claim 1, wherein the mode-switching structure comprises a rotating mechanism, wherein the plurality of modules are connected to the rotating mechanism and arranged in a rotary configuration.
3. The system of claim 1 or 2, further comprising at least one steam-redirecting unit, configured to redirect water vapor desorbed from the at least one module in desorption mode to the at least one condenser.

4. The system of any one of claims 1 to 3, wherein each module further comprises a frame to hold together the structural elements.
5. A water harvesting system for capturing water from surrounding air, comprising:
 - an adsorption/desorption unit, comprising:
 - at least one structural element,
 - wherein at least a portion of each structural element supports at least one water capture material,
 - wherein the at least one water capture material adsorbs water from surrounding air when in adsorption mode, and desorbs water in the form of water vapor when in desorption mode;
 - at least one condenser, positioned in proximity to the at least one structural element, and configured to condense water vapor into liquid water; and
 - at least one air-circulating unit, wherein the at least one air-circulating unit is configured to simultaneously (i) draw surrounding air into the at least one module operating in adsorption mode, thereby assisting adsorption of water by the at least one water capture material in the module from the surrounding air, and (ii) circulate air to cool the at least one condenser.
6. The system of any one of claims 1 to 5, wherein the at least one structural element is a conductive element.
7. The system of any one of claims 1 to 6, wherein the adsorption/desorption unit is configured to directly heat the at least one structural element and minimize waste heat.
8. The system of any one of claims 1 to 6, further comprising at least one heat exchange manifold connected to, or positioned around, the at least one structural element.
9. The system of any one of claims 1 to 8, wherein the at least one structural element is at least one plate.
10. The system of claim 9, wherein the at least one plates are arranged radially or parallel to each other within the module.

11. A water harvesting system for capturing water from surrounding air, comprising:
an adsorption/desorption unit, comprising:
a plurality of modules arranged in a rotary configuration,
wherein each module comprises at least one conductive element,
wherein at least a portion of each conductive element is coated with at
least one water capture material,
wherein the at least one water capture material adsorbs water from
surrounding air when the module is in adsorption mode, and desorbs
water in the form of water vapor when the module is in desorption
mode;
a rotating mechanism, wherein the plurality of modules are mounted onto the
rotating mechanism, and configured to concurrently switch at least one
module from adsorption mode to desorption mode and at least one module
from desorption mode to adsorption mode;
at least one condenser, positioned in proximity to the at least one module in desorption
mode, and configured to condense water vapor into liquid water; and
at least one air-circulating unit, configured to draw surrounding air into each module in
adsorption mode and circulate the air in the adsorption/desorption unit, thereby
assisting adsorption of water by the at least one water capture material from the
surrounding air.
12. The system of claim 11, further comprising at least one steam-redirecting unit, configured
to redirect water vapor desorbed from the at least one module in desorption mode to the at least
one condenser.
13. The system of claim 11 or 12, wherein the at least one condenser is positioned in the
interior of the plurality of modules arranged in a rotary configuration.
14. The system of any one of claims 1 to 13, wherein the at least one conductive element is at
least one metal plate.
15. The system of claim 14, wherein the at least one metal plates are arranged radially or
parallel to each other within the module.

16. The system of any one of claims 1 to 15, wherein the at least one water capture material comprises metal organic framework.
17. The system of any one of claims 1 to 15, wherein the at least one water capture material comprises desiccant material.
18. The system of any one of the preceding claims, further comprising a sealing structure, configured to seal one or more modules in desorption mode.
19. The system of any one of the preceding claims, further comprising at least one collection unit, configured to receive the liquid water from the at least one condenser.
20. The system of any one of the preceding claims, further comprising a control system configured to monitor and control adsorption, desorption and condensation, wherein the control system comprises: at least one sensor; and at least one processor unit.
21. The system of any one of the preceding claims, wherein an air stream exits the at least one condenser, and the system further comprises at least one recirculating unit, configured to recycle the air stream exiting the at least one condenser to at least one module in desorption mode.
22. The system of any one of the preceding claims, further comprising at least one float valve, configured to collect the liquid water by gravity without any substantial loss of air.
23. The system of claim 22, further comprising at least one collection unit, configured to receive the liquid water exiting the at least one condenser through the at least one float valve.
24. The system of any one of the preceding claims, further comprising at least one housing unit to hold the adsorption/desorption unit, at least one condenser and at least one air circulating unit.
25. A method of harvesting water from surrounding air using a water harvesting system of any one of claims 1 to 3 and 17 to 24, comprising:
 - a) adsorbing water from surrounding air in at least one module in adsorption mode;

- b) desorbing at least a portion of water in at least one of the remaining modules in desorption mode;
 - c) condensing at least a portion of the water vapor release from the at least one module in desorption mode using the at least one condenser to produce liquid water, wherein steps (a)-(c) occur concurrently; and
 - d) switching at least one module in adsorption mode to desorption mode and at least one of the remaining modules in desorption mode to adsorption mode.
26. A method of harvesting water from surrounding air using a water harvesting system of any one of claims 4 to 9 and 17 to 24, comprising:
- a) drawing surrounding air into at least one module in adsorption mode to assist adsorption of water by the at least one water capture material and to assist cooling of the at least one condenser, wherein the air is recirculated or recycled to assist with adsorption and cooling;
 - b) heating at least one of the remaining modules in desorption mode to assist desorption of at least a portion of water from the at least one water capture material; and
 - c) condensing at least a portion of the water vapor release from the at least one module in desorption mode using the at least one condenser to produce liquid water.
27. A method of harvesting water from surrounding air using a water harvesting system of any one of claims 10 to 24, comprising:
- a) adsorbing water from surrounding air in at least one module in adsorption mode;
 - b) desorbing at least a portion of water in at least one of the remaining modules in desorption mode;
 - c) condensing at least a portion of the water vapor release from the at least one module in desorption mode using the at least one condenser to produce liquid water, wherein steps (a)-(c) occur concurrently; and
 - d) rotating at least one module in adsorption mode to desorption mode and at least one of the remaining modules in desorption mode to adsorption mode.

28. The method of any one of claims 25 to 27, wherein an air stream exits the at least one condenser, and the method further comprises recycling the air stream exiting the at least one condenser to the at least one module in desorption mode.