



(51) International Patent Classification:

B08B 3/10 (2006.01) **H01L 21/304** (2006.01)
H01L 21/302 (2006.01)

(21) International Application Number:

PCT/IB2013/050030

(22) International Filing Date:

2 January 2013 (02.01.2013)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/582,482 2 January 2012 (02.01.2012) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD,

ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))
- of inventorship (Rule 4.17(iv))

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) Title: METHODS AND SYSTEMS FOR CLEANING FOR CYCLIC NUCLEATION TRANSPORT (CNX)

Providing an object in a chamber, wherein the chamber is isolated from outside ambient
400

Flowing a superheated liquid to the chamber to at least partially submerge the object, wherein the superheated liquid has a temperature above the boiling temperature at atmospheric pressure, wherein the superheated liquid partially fills the chamber so that the chamber comprises a liquid portion and a vapor portion
410

Periodically releasing the vapor pressure in the vapor portion
420

Fig. 4

(57) **Abstract:** A hyperbaric cyclic nucleation transport (H-CNX) process is disclosed, including pressure cycling liquid and/or vapor from pressure higher than atmospheric pressure or vapor across the boiling point of the liquid. The higher pressure can be accompanied by higher temperature, which provides additional benefits of more efficient cleaning and cheaper liquid medium. A dynamic cyclic nucleation transport (D-CNX) process is disclosed, including cyclically changing the volume of a process chamber, for example, through a piston or bellows. A D-CNX process and system can include a dynamic chamber volume that can instantly change from vacuum to pressure conditions and eliminates vacuum pumps. Methods are disclosed to create and employ the use of non-vapor, non-condensable gas bubbles inside a process chamber. These non-vapor gas bubbles may be rapidly expanded and compressed in pressure-controlled cycles and can assist in the transport of fluids, particles, and by-products to and from surfaces. The gas bubbles can be generated from dissolved gas to the liquid medium, by mixing two liquids that can react with each other to generate gaseous by-products, or by using a liquid medium that can react with the surface of the object to generate gaseous by-products. The gaseous generation can be used with cyclic nucleation transport (CNX) process, such as vacuum CNX, hyperbaric CNX, or dynamic CNX.

