

(51) International Patent Classification:
H01L 21/205 (2006.01)(21) International Application Number:
PCT/US2013/028214(22) International Filing Date:
28 February 2013 (28.02.2013)

(25) Filing Language: English

(26) Publication Language: English

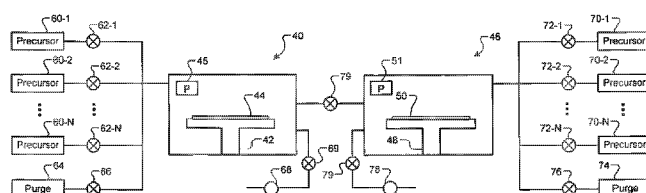
(30) Priority Data:
61/605,231 1 March 2012 (01.03.2012) US
13/779,056 27 February 2013 (27.02.2013) US(71) Applicant: NOVELLUS SYSTEMS, INC. [US/US];
4000 North First Street, San Jose, California 95134 (US).(72) Inventor: LEESER, Karl; 6152 SW Bonita Rd. Apt.
A201, Lake Oswego, Oregon 97035 (US).(74) Agents: WIGGINS, Michael D. et al.; Harness, Dickey &
Pierce, P.L.C., P.O. Box 828, Bloomfield Hills, Michigan
48303 (US).(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))

Published:

- with international search report (Art. 21(3))
- with amended claims (Art. 19(1))

(54) Title: SEQUENTIAL CASCADING OF REACTION VOLUMES AS A CHEMICAL REUSE STRATEGY

**FIG. 3**

(57) **Abstract:** A substrate processing system includes one or more processing chambers defining N reaction volumes. N-1 first valves are arranged between the N reaction volumes. A controller communicates with the N-1 first valves and is configured to pressurize a first one of the N reaction volumes with precursor gas to a first target pressure, wait a first predetermined soak period, evacuate a second one of the N reaction volumes to a second target pressure that is lower than the first target pressure, and open one of the N-1 first valves between the first one of the N reaction volumes and a second one of the N reaction volumes.