

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau

(43) International Publication Date
12 August 2021 (12.08.2021)



(10) International Publication Number
WO 2021/156688 A1

- (51) **International Patent Classification:**
H01L 23/532 (2006.01)
- (21) **International Application Number:**
PCT/IB2021/050189
- (22) **International Filing Date:**
12 January 2021 (12.01.2021)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
16/781,038 04 February 2020 (04.02.2020) US
- (71) **Applicant:** **INTERNATIONAL BUSINESS MACHINES CORPORATION** [US/US]; New Orchard Road, Armonk, New York, 10504 (US).
- (71) **Applicants (for MG only):** **IBM UNITED KINGDOM LIMITED** [GB/GB]; PO Box 41, North Harbour, Portsmouth Hampshire PO6 3AU (GB). **IBM (CHINA) INVESTMENT COMPANY LIMITED** [CN/CN]; 25/F, Pangu Plaza, No.27, Central North 4th Ring Road, Chaoyang District, Beijing 100101 (CN).
- (72) **Inventors:** **MANISCALCO, Joseph**; IBM CORPORATION, 257 Fuller Road, Albany, New York 12203-3654 (US). **MOTOYAMA, Koichi**; IBM CORPORATION, 257 Fuller Road, Albany, New York 12203-3654 (US). **VAN DER STRATEN, Oscar**; IBM CORPORATION, 257 Fuller Road, Albany, New York 12203-3654 (US).

DEVRIES, Scott; IBM CORPORATION, 257 Fuller Road, Albany, New York 12203-3654 (US). **REZNICEK, Alexander**; IBM CORPORATION, 257 Fuller Road, Albany, New York 12203-3654 (US).

(74) **Agent:** **WILLIAMS, Julian**; IBM United Kingdom Limited, Intellectual Property Law, Hursley Park, Hursley, Winchester Hampshire SO21 2JN (GB).

(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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, 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, ST, 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, KM, ML, MR, NE, SN, TD, TG).

(54) **Title:** INTERCONNECT STRUCTURES WITH COBALT-INFUSED RUTHENIUM LINER AND A COBALT CAP

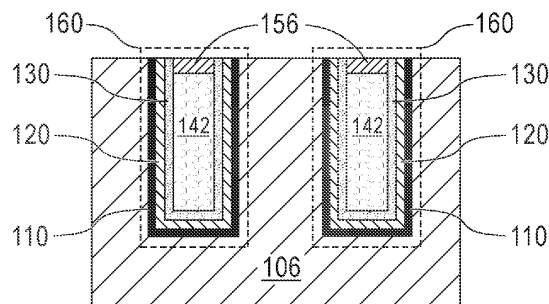


FIG. 1F

(57) **Abstract:** An interconnect structure, and a method for forming the same includes forming recess within a dielectric layer and conformally depositing a barrier layer within the recess. A cobalt-infused ruthenium liner is formed above the barrier layer, the cobalt containing ruthenium liner formed by stacking a second liner above a first liner, the first liner positioned above the barrier layer. The first liner includes ruthenium while the second liner includes cobalt. Cobalt atoms migrate from the second liner to the first liner forming the cobalt-infused ruthenium liner. A conductive material is deposited above the cobalt-infused ruthenium liner to fill the recess followed by a capping layer made of cobalt.

[Continued on next page]



WO 2021/156688 A1

Published:

- with international search report (Art. 21(3))
- in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE