

(19) World Intellectual Property Organization
International Bureau



G00002



(43) International Publication Date
20 June 2002 (20.06.2002)

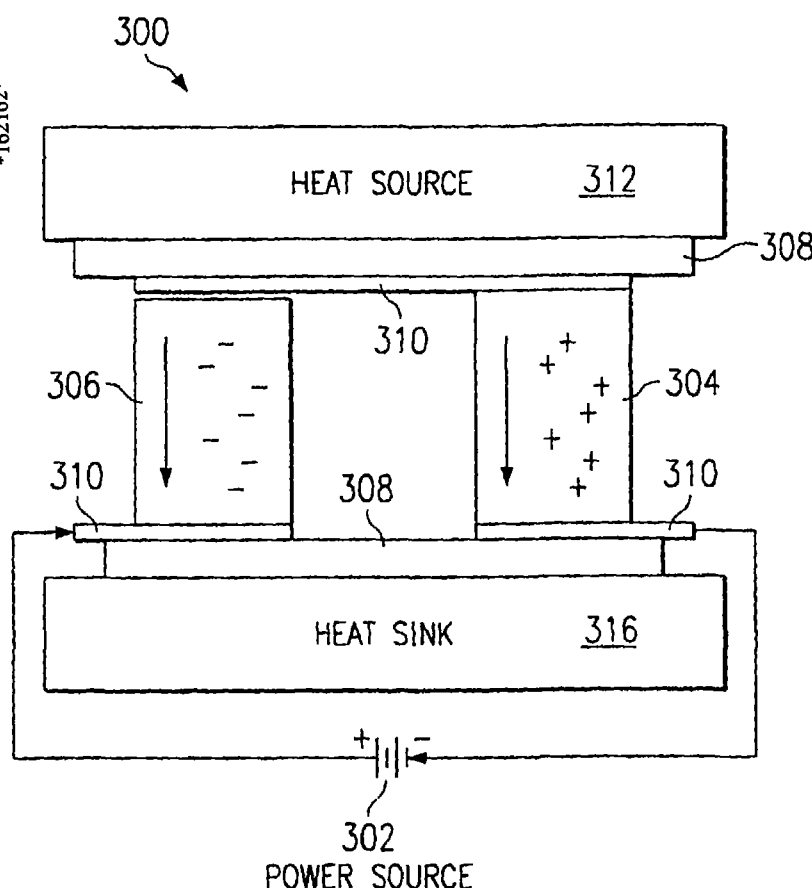
PCT

(10) International Publication Number
WO 02/049105 A3

- (51) International Patent Classification⁷: **H01L 23/38**, 23/66
- (21) International Application Number: PCT/GB01/05469
- (22) International Filing Date:
11 December 2001 (11 12 2001)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
09/734,519 11 December 2000 (11 12 2000) US
- (71) Applicant: **INTERNATIONAL BUSINESS MACHINES CORPORATION** [US/US]. New Orchard Road, Armonk, NY 10504 (US).
- (71) Applicant (for MG only): **IBM UNITED KINGDOM LIMITED** [GB/GB], PO Box 41, North Harbour, Portsmouth, Hampshire PO6 3AU (GB)
- (72) Inventor: **GHOSHAL, Uttam, Shyamalindu**, 10421 Indigo Broom Loop, Austin, TX 78733 (US).
- (74) Agent: **JENNINGS, Michael, John**. IBM United Kingdom Limited, Intellectual Property Law, Hursley Park, Winchester, Hampshire SO21 2JN (GB)
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW

[Continued on next page]

(54) Title: THERMOELECTRIC SPOT COOLERS FOR RF AND MICROWAVE COMMUNICATION INTEGRATED CIRCUITS



(57) Abstract: An apparatus for cooling selected elements within an integrated circuit, such as active transistors or passive circuit elements used in a radio frequency integrated circuit is provided. In one embodiment, the cooling apparatus includes a cold plate thermally coupled to the region proximate the integrated circuit element, a thermoelectric cooler thermally coupled to the cold plate, and a hot plate thermally coupled to the thermoelectric cooler. Heat is removed from the integrated circuit element through the cold plate and transmitted to the hot plate through the thermoelectric cooler. In one form, the hot plate is located or coupled to an exterior surface of an integrated circuit, such that heat transmitted to the ambient from the integrated circuit element is dissipated into the atmosphere surrounding the integrated circuit. In another form, the hot plate is embedded in the integrated circuit substrate to locally cool elements of the integrated circuit while dumping the heat into the substrate.



(84) **Designated States (regional):** ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

(88) **Date of publication of the international search report:**
5 December 2002

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette

Published:

— with international search report