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**Declarations under Rule 4.17:**

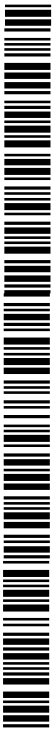
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(U))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(Ui))

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(54) **Title:** A HETEROJUNCTION BIPOLAR TRANSISTOR (HBT) WITH PERIODIC MULTI LAYER BASE



WO 2008/024587 A3

S<sup>-200</sup>

Silicon cap layer	215
SiGeC - no boron	213
SiGe - no carbon, no boron	211
SiGe - boron doped	209
SiGe - no carbon, no boron	207
SiGeC - no boron	205
Silicon seed layer	203
p-type silicon substrate with collector region	201

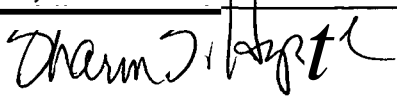
Fig. 2

(57) **Abstract:** A method and resulting electronic device utilizing periodic multi-layer (ML) (500) and/or superlattice (SL) structures in the base of a SiGe heterojunction bipolar transistor (HBT) is disclosed. The SL is a special case of an ML, in which layers that are chemically different from adjacent neighbors are successively repeated. The use of the ML (500) in electronic and photonic devices enables strategic engineering of the energy band gap (551, 553) and carrier mobilities. Principles disclosed herein relate to npn- and pnp-type SiGe HBTs as well as HBTs made with other compound semiconductor materials (e.g., other Group III-V or II-VI materials). Additionally, technology and methods disclosed herein benefit other device types such as, for example, metal oxide semiconductor field effect transistors (MOSFETs), high electron mobility transistors (HEMTs), high hole mobility transistors (HHMTs), bipolar junction transistors (BJTs), and FINFETs.

## INTERNATIONAL SEARCH REPORT

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<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC: <b>HOIL 31/11( 2006.01)</b>  USPC: 257/187 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) U S . : 257/187  Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- A	US 6,759,694 B1 (Hsu et al.) 06 July 2004 (06.07.2004), figs 1-6 and col. 1, lines 44-64; col. 3, line 8-col. 5, line 50.	1-17 ----- 18-22
<b>D</b> Further documents are listed in the continuation of Box C <input type="checkbox"/> See patent family annex.		
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"A"	document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"O"	document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed	
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05 May 2008 (05.05.2008)		<b>18 JUN 2000</b>
Name and mailing address of the ISA/US Mail Stop PCT, Attn ISA/US Commissioner for Patents P O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201		Authorized officer /Dao H. Nguyen/  Telephone No. 571-272-1791