INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

MATERIALS MANAGEMENT DIVISION

PR No. 1000049276 **RFQ No. 3600002997**

Epitaxial Growth of Si/SiGe heterostructures on Si(100) substrates with subsurface strained Si quantum well

Sr. No.	Feature	Specification	Technical compliance (YES/NO)	Additional information (if any)
1	Substrate	Single-side-polished p-type Silicon wafers of 200 mm diameter, with miscut angle ≤ 0.5°, thickness varying between 500 μm to 750 μm and resistivity varying between 10 Ohm-cm and 100 Ohm-cm.		
2	Heterostructure	**SAMPLE 1 (2 Nos.)** **Layer 1**: 3-μm-thick, linearly graded $Si_{1-x}Ge_x$ buffer layer with Ge content (x) varying from x = 0 in the bottom, to x = 0.3 in the end. **Layer 2**: 1-μm-thick, $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. **Layer 3:** 225-nm thick, $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. **Layer 4:** 8-nm thick, Si quantum well.		

		Layer 5: 40-nm thick, $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. **Layer 6:** 2-nm thick, Si cap. **SAMPLE 2 (4 Nos.)** **Layer 1**: 3-μm-thick, linearly graded $Si_{1-x}Ge_x$ buffer layer with Ge content (x) varying from x = 0 in the bottom, to x = 0.3 in the end. **Layer 2**: 1-μm-thick, $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. **Layer 3:** 225-nm thick, $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. **Layer 4:** 8-nm thick, Si quantum well. **Layer 5:** 50-nm thick, $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. **Layer 6:** 2-nm thick, Si cap. **SAMPLE 3 (2 Nos.)** **Layer 1**: 3-μm-thick, linearly graded $Si_{1-x}Ge_x$ buffer layer with Ge content (x) varying from x = 0 in the bottom, to x = 0.3 in the end. **Layer 2**: 1-μm-thick, $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. **Layer 3:** 225-nm thick, $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. The $Si_{1-x}Ge_x$ buffer layer should contain isotopically purified Si, with the ^{29}Si isotope reduced to 800 ppm or lower. **Layer 4:** 8-nm thick, Si quantum well. The quantum well should contain isotopically purified Si, with the ^{29}Si isotope reduced to 800 ppm or lower.		

		Layer 5: 40-nm thick $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. The $Si_{1-x}Ge_x$ buffer layer should contain isotopically purified Si, with the ^{29}Si isotope reduced to 800 ppm or lower. **Layer 6:** 2-nm thick, Si cap. **SAMPLE 4 (3 Nos.)** **Layer 1**: 3-μm-thick, linearly graded $Si_{1-x}Ge_x$ buffer layer with Ge content (x) varying from x = 0 in the bottom, to x = 0.3 in the end. **Layer 2**: 1-μm-thick, $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. **Layer 3:** 225-nm thick, $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. The $Si_{1-x}Ge_x$ buffer layer should contain isotopically purified Si, with the ^{29}Si isotope reduced to 800 ppm or lower. **Layer 4:** 8-nm thick, Si quantum well. The quantum well should contain isotopically purified Si, with the ^{29}Si isotope reduced to 800 ppm or lower. **Layer 5:** 50-nm thick $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. The $Si_{1-x}Ge_x$ buffer layer should contain isotopically purified Si, with the ^{29}Si isotope reduced to 800 ppm or lower. **Layer 6:** 2-nm thick, Si cap. **SAMPLE 5 (3 Nos.)** **Layer 1**: 3-μm-thick, linearly graded $Si_{1-x}Ge_x$ buffer layer with Ge content (x) varying from x = 0 in the bottom, to x = 0.3 in the end. **Layer 2**: 1-μm-thick, $Si_{1-x}Ge_x$ buffer layer		

		with constant Ge content (x) x = 0.3. **Layer 3:** 225-nm thick, $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. The $Si_{1-x}Ge_x$ buffer layer should contain isotopically purified Si, with the ^{29}Si isotope reduced to 800 ppm or lower. **Layer 4:** 8-nm thick, Si quantum well. The quantum well should contain isotopically purified Si, with the ^{29}Si isotope reduced to 800 ppm or lower. **Layer 5:** 60-nm thick $Si_{1-x}Ge_x$ buffer layer with constant Ge content (x) x = 0.3. The $Si_{1-x}Ge_x$ buffer layer should contain isotopically purified Si, with the ^{29}Si isotope reduced to 800 ppm or lower. **Layer 6:** 2-nm thick, Si cap.		
3	Process	1. The required Si wafers, as specified earlier, should be procured and provided by the vendor 2. All layers should be grown by chemical vapor deposition, using appropriate gas source precursors 3. A sufficiently low and uniform growth temperature of layers 3, 4, 5 and 6 should be chosen to avoid Ge intermixing of the Si quantum well. 4. Before growth of layer 3, chemical-mechanical polishing of layer 2 should be carried out. The as-grown thickness of layer 2 should be such that after CMP of this layer, the remaining thickness is 1 μm		
4	Metrology	1. The thickness variation of layers 1, 2 and 3 should be maintained to within 10 % of the specified		

		values, as measured by XTEM 2. The thickness variation of layers 4, 5 and 6 should be maintained to within ± 1 nm of the specified values, as measured by XTEM 3. The Ge-content of the $Si_{1-x}Ge_x$ layers (layers 1, 2, 3 and 5) should be maintained to within 1 % of the specified values, as measured by SIMS 4. All thickness and composition calibration data should be provided along with the heterostructure samples. 5. The specifications of the used wafers, supporting compliance to the specifications provided for the same, should be provided by the vendor.		