The ATLAS experiment will replace its existing Inner Detector with the new all-silicon Inner Tracker (ITk) to cope with the operating conditions of the forthcoming high-luminosity phase of the LHC (HL-LHC). The outer regions of the ITk will be instrumented with ~18000 ATLAS18 strip sensors fabricated by Hamamatsu Photonics K.K. (HPK). With the launch of full-scale production of 20800 sensors in 2021 (including anticipated losses during assembly), the ITk strip sensor community has undertaken quality control (QC) testing of these sensors to ensure compliance with mechanical and electrical specifications agreed with HPK. The testing is conducted at seven QC sites on each of the monthly deliveries of ~500 sensors.

Sensor quality control (QC) programme

Each site generally focusses on sensors of particular geometries (barrel or endcap). Flexibility to test other flavours when load sharing required.

QC tests on every sensor

Visual inspection:
- Look for chips, scratches, etc.

Visual image capture:
- 2 × 2 mm² resolution scan of sensor, for warranty purposes

Sensor IV:
- $V_{emb}$ $> 500V$: no breakdown at maximum operating voltage

Sensor CV:
- $|V_{<500V}| < 0.1\mu$A/cm²

QC tests on batch subset

Mechanical thickness:
- $|\text{thickness} - 300\mu m| < 15\mu m$

Long-term leakage current stability (10%-20%;)
- $|\Delta I| < 15\%$ for 24h

Full strip test (2%-5%;)
- Per strip: $I_{leak} < 200nA$, 1MD $< R_{leak} < 2M\Omega$, $C_{leak} < 20pF/cm$
- $< 1\%$ failed strips/segment
- $< 8$ consecutive failed strips

Conclusions

Since August 2021, Hamamatsu Photonics K.K. (HPK) has been fabricating strip sensors for the ATLAS Inner Tracker (ITk) detector. Through collaborative discussions with ATLAS, HPK has overcome challenges in early stages of production to deliver 63% of the production order. Recovery treatments applied by ATLAS QC sites have reduced the sensor rejection rate to 3.7%. Nearly 11000 strip sensors, representing 53% of the required total, have been accepted for use in the ITk detector.

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