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Quantum Hall effect in epitaxial graphene - a metrological perspective[1]

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Although the QHE has been used successfully for more than two decades to realise the resistance scale, graphene has potential to supersede conventional semiconductors as the material of choice for quantum electrical metrology. The physical mechanisms giving graphene, grown on SiC in particular, an edge over the conventional semiconductors include the pinning of the filling factor over an extraordinarily broad range of magnetic field, large inter-Landau level spacing and a very short energy relaxation time. Together they lead to a very robust quantum Hall state opening an opportunity to realise the quantum resistance standard of greatly reduced cost and complexity operating at high temperatures, low magnetic fields and high signal-to-noise ratio. I will review the progress achieved in graphene engineering, physical understanding and metrology from the first accurate QHE measurements performed on exfoliated samples (with precision of 15 parts in 10^6) and on graphene on SiC (3 parts in 10^9) to a direct comparison between graphene on SiC and GaAs demonstrating equivalence of the quantised values of the Hall resistance with a relative uncertainty of 8.6 parts in 10^{11}.

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