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ANDERSSON, M., Vorobiev, A., Gevorgian, S. et al (2014). Comparison of carrier scattering mechanisms in chemical vapor deposited graphene on fused silica and strontium titanate substrates. Graphene Week 2014

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Comparison of carrier scattering mechanisms in chemical vapor deposited graphene on fused silica and strontium titanate substrates

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Graphene is explored for numerous applications for both electronics and photonics. These range from high frequency and low noise field effect transistors [1] to conductive and highly transparent LED electrodes [2]. To exploit the full potential of graphene, the remarkable intrinsic carrier transport properties and tunable, potentially low sheet resistance must be efficiently utilized. However, graphene carrier mobility is currently strongly degraded by extrinsic factors arising mainly from the dielectric environment, i.e. substrate and gate oxide [3, 4]. A proposed route to enhance transport is the use of a high- κ substrate to screen charged impurities at the graphene-substrate interface.

In this paper, mobility and carrier concentration in CVD grown graphene films on fused silica (FS, $\kappa=3.9$) and strontium titanate (STO, $\kappa=300$) substrates are extracted from microwave measurements, and compared to Hall data (red symbols), as presented in Fig. 1. Also shown is solid lines are the modelled mobilities including scattering by charged impurities (CI), substrate polar phonons (SPP) and resonant centers (RS). The scattering contributions are compared in Fig. 2, where resonant scatterers dominates on strontium titanate and together with charged impurities on fused silica. While resonant scatterers are likely reduced by moving from wet to dry graphene transfer methods, the nominal mobility improvement by screening of charged impurities on high- κ strontium titanate would be masked at room temperature by increased surface phonon scattering.

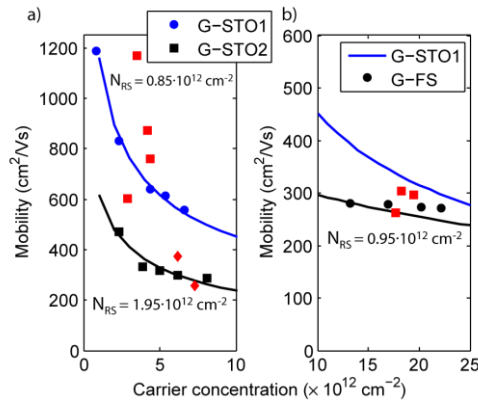


Fig. 1. Extracted mobility versus carrier concentration (symbols) from microwave measurements and theoretical fit (solid lines). Impurity concentration $N_{CI}=4 \cdot 10^{12} \text{ cm}^{-2}$.

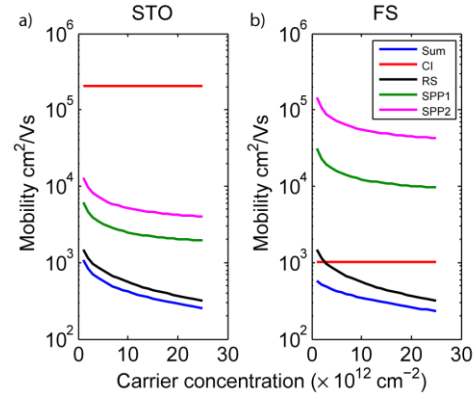


Fig. 2. Mobility divided by scattering mechanism. Impurity concentration $N_{CI}=4 \cdot 10^{12} \text{ cm}^{-2}$. Resonant scatterers has concentration $N_{RS}=1 \cdot 10^{12} \text{ cm}^{-2}$.

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