Influence of structural quality on the carrier dynamics in graphene

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Production of large-scale high quality graphene is a challenging task. Therefore understanding how quality will influence the properties of graphene is crucial for industrial applications. In this work we focus on the influence of defects on the carrier dynamics. To this end areas of a multilayer epitaxial graphene sample with high structural quality [1] are irradiated with different doses of low energy carbon ions. The different areas with now varying graphene quality (see D-Peaks in Raman spectra in Figure 1) are studied by a pump-probe experiment utilizing low energetic photons from a free-electron laser (photon energy 75meV). In this regime carrier relaxation is particularly slow as compared to excitation with visible light since scattering with optical phonons (energy 200meV) is efficiently suppressed [2]. The change in transmission is depicted in Figure 2 for three different structural qualities. One can directly see that the relaxation in the damaged areas is significantly faster than in the pristine graphene. This might be an indication for the presence of the intensively discussed supercollisions in graphene [3].

References

[1] C. Berger et al., Science 312, 1191 (2006).
[2] S. Winnerl et al., Phys. Rev. Lett. 107, 237401 (2011).
[3] J. C. W. Song et al., Phys. Rev. Lett. 109, 106602 (2012).

Figures

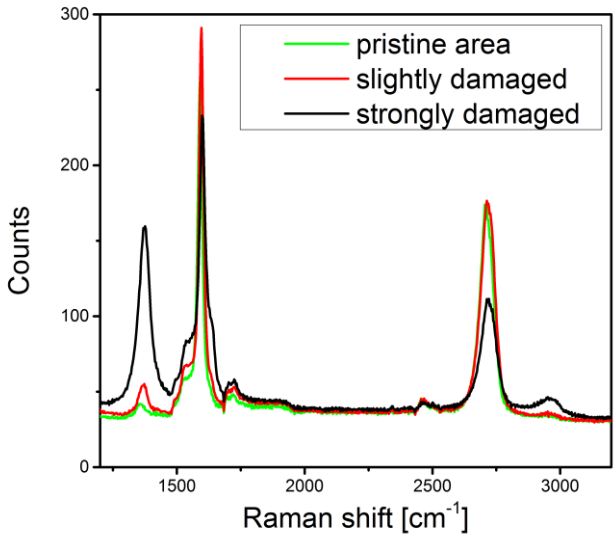

Figure 1: Raman spectra of pristine graphene (green) and of areas irradiated with doses $1*10^{12}$ cm^{-2} (red) and $5*10^{13}$ cm^{-2} (black).

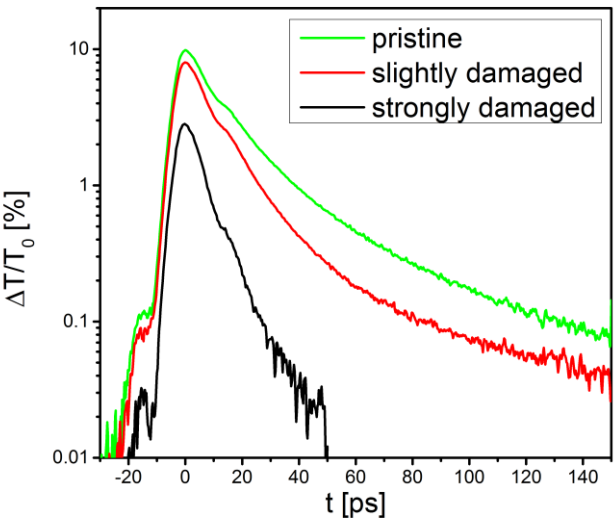

Figure 2: Pump-probe transients of graphene areas with different structural quality. The damaged areas possess a faster dynamics.