# X-ray induced remote graphene doping via defect charging in gate dielectric

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Graphene field effect transistors are becoming an integral part of advanced devices. Hence, the advanced strategies for both characterization and tuning of graphene properties are required. Here we show that the X-ray irradiation at the zero applied gate voltage causes very strong negative doping of graphene, which is explained by X-ray radiation induced charging of defects in the gate dielectric. The induced charge can be neutralized and compensated if the graphene device is irradiated by X-rays at a negative gate voltage. Here the charge neutrality point shifts back to zero voltage. The observed phenomenon has strong implications for interpretation of X-ray based measurements of graphene devices as it renders them to significantly altered state. Our results also form a basis for remote X-ray tuning of graphene transport properties and X-ray sensors comprising the graphene/oxide interface as an active layer.

Figures

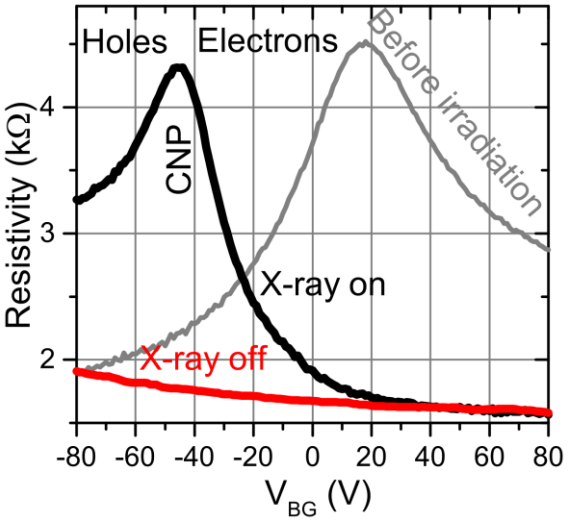


**Figure 1:** Graphene resistivity as a function of gate voltage $V_{BG}$ measured before any irradiation is given in grey. Upon soft X-ray irradiation the Charge Neutrality Point (CNP) shifts to lower $V_{BG}$ (black) and if the irradiation is turned off the CNP shifts further towards the lower (higher negative) values of $V_{BG}$ (red, note that CNP is now outside the measurable range). Upon repeated X-ray irradiation CNP reproducibly shifts between X-on (black) and X-off (red) state.