# Channel Hot Carrier degradation of back-gated GFETs exposed to air: a combined nanoscale and device level study

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In this work we study the Channel Hot Carrier (CHC) degradation [1] of back-gated graphene field-effect transistors (GFETs) with their channel exposed to air [2]. A measurement-stress-measurement procedure has been adopted, using a Semiconductor Parameter Analyzer (SPA) to stress and measure at the device level and a Conductive Atomic Force Microscope (CAFM) to measure the graphene properties at the nanoscale. To combine measurements at the two scales, a custom-made system has been implemented, to avoid moving the sample and decrease the time between electrical stress and nanoscale measurement (Fig.1). Nanoscale measurements show a consistent decrease of conductive graphene area with longer CHC stress times(Fig.2a/b). Surprisingly, device level measurements do no show an important change in the conductivity of the GFET as one may expect from the level of damage of the graphene channel detected at the nanoscale. This could affect the performance, for example, of sensor devices that rely on the graphene channel morphology or defects to promote the detection of molecules [3].

References

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[2] C.Hummel, F.Schwierz, A.Hanisch, J.Pezoldt, Journal, Physica Status Solidi B (2010), pp. 903-906
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Figures

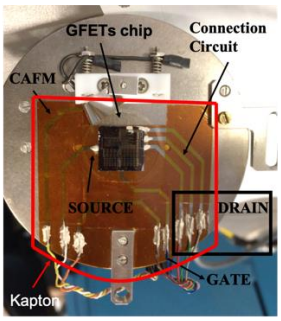


**Figure 1:** Detail of the custom-made measuring system of fully processed electron-devices. A switch unit (not shown) is used to alternate measurements between the SPA and CAFM. The connection of the DUT is done with an interface fabricated by means of ink-jet printing.

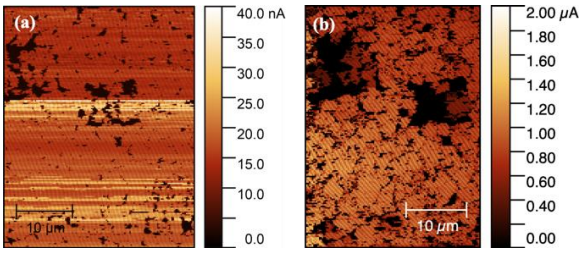


**Figure 2:** CAFM image of the same region of the graphene channel before (a) and after 8h of CHC stress (b). Black colour indicates zero current, that corresponds to the presence of defects in the graphene layer.