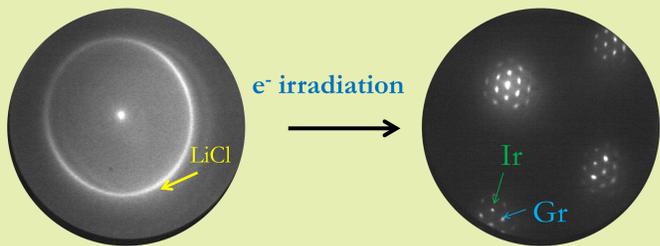


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Alkali halide thin films grown on different substrates are an important system for studying single molecules, nanoparticles and nanostructures. However, there still is a lack in the comprehension of their stability upon electron and photon irradiation.

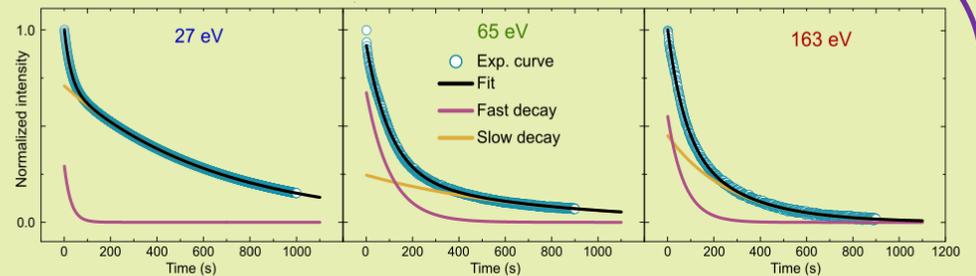
In this work we study the mechanisms involved in the desorption of ultra-thin LiCl films on graphene grown on Ir(111) upon low-energy electron irradiation. The same system has been recently studied upon soft X-Ray photon irradiation, where, in addition to LiCl desorption, Li intercalation into graphene was found [1]. In the present case, we have employed Low-Energy Electron Diffraction and Microscopy (LEED and LEEM) techniques (LEEM/PEEM end station of CIRCE beamline at ALBA synchrotron) to follow the desorption kinetics in real time, finding no evidences of Li intercalation. The fitting of LEED intensity curves shows a bi-exponential decay behavior where two regimes (fast and slow) are observed. The ratio of both regimes strongly depends on the energy of the impinging electrons. This bi-exponential behavior has been previously reported for NaCl thin films on metallic substrates [2]. In addition, we have compared the differences between an electron-irradiated LiCl thin film vs a photon-irradiated one, finding out that photon-irradiated samples show a mono-exponential decay desorption behavior.

## Low-energy electron irradiation



An initial fast decay evolves to a slow decay

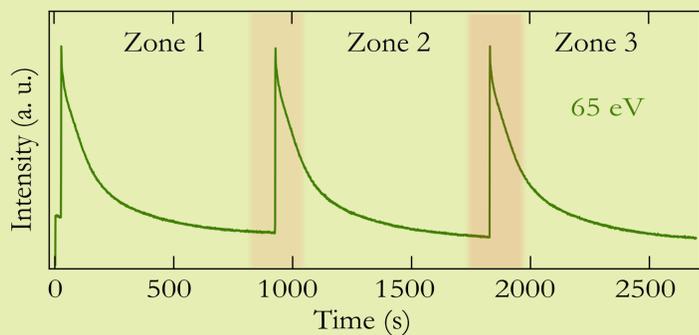
## Curve fitting: bi-exponential decay function



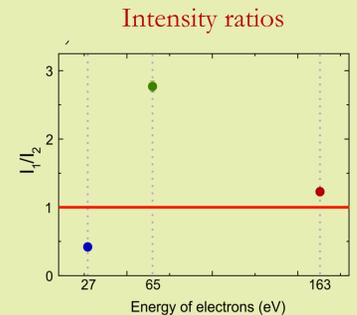
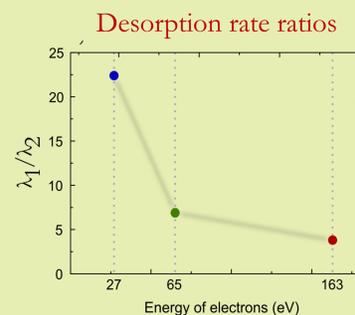
Fitting parameters

Energy (eV)	$\tau_1$ (s)	$\tau_2$ (s)	$\lambda_1$ (1/s)	$\lambda_2$ (1/s)
27	28.8±0.1	646±1	0.0347±1.10 <sup>-4</sup>	0.001548±3.10 <sup>-6</sup>
65	105±1	725±89	0.0095±1.10 <sup>-4</sup>	0.0014±1.10 <sup>-4</sup>
163	72±1	274±6	0.0138±2.10 <sup>-4</sup>	0.00365±1.10 <sup>-4</sup>

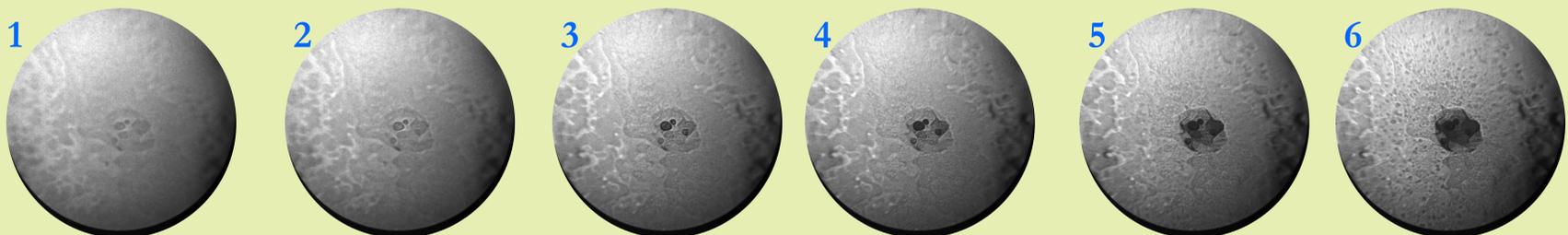
LEED: LiCl pattern faints and Gr/Ir(111) signal emerges



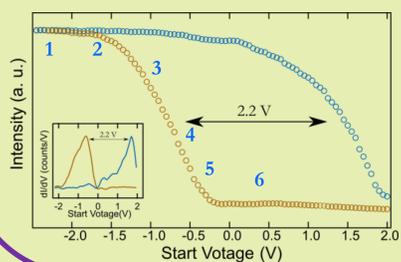
Relation between desorption rates and intensities



## MEM-LEEM transition

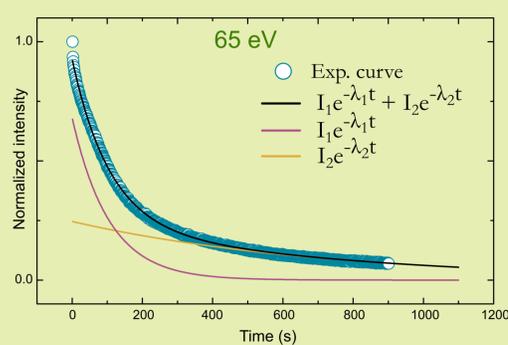


Increase Start Voltage



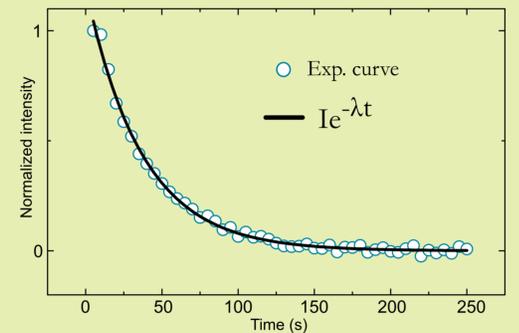
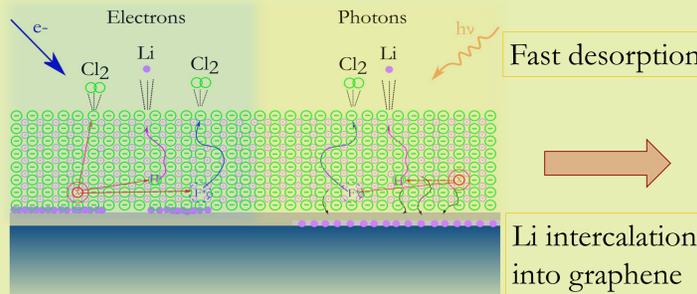
- Brown curve: irradiated zone (Gr/Ir(111))
- Blue curve: non-irradiated zone (LiCl/Gr/Ir(111))
- Previously irradiated zone shows contrast in LEEM mode.
- MEM-LEEM transition takes place at lower SV values in the irradiated zone
- Implies differences in Work Function ( $\Phi$ ): 2.2 eV. Electrons of the irradiated zone need less energy to escape from surface.

## Electrons vs. photons



Fast and slow desorption

Disordered Li clusters on graphene



## SUMMARY

- LiCl LEED intensity signal behaves as a bi-exponential decay function: there is a fast and a slow desorption regime which relation depends on the energy of the incident electrons.
- LiCl desorption implies changes in local  $\Phi$ .
- Photon-induced desorption: fast, mono-exponential behavior and Li intercalation into graphene.
- The relaxation processes of the primary excitations created due to both electron and photon irradiation are different.

## Bibliography

1. J. Azpeitia *et al.* ACS Appl. Mater. Interfaces **13**, 42205 (2021)
2. A. Husseem *et al.* Phys. Rev. B **96**, 235418 (2017)

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