# Electronic interaction of organic molecules with nitrogen doped graphene

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Tuning the physical properties of graphene is one of the current challenges in the field of 2D materials. Among the possible strategies to attain this goal, the chemical doping consisting in the insertion of foreign atoms in the carbon lattice has attracted much attention. More specifically, nitrogen doping has been particularly investigated since it allows to achieve electronic doping without noticeable structural relaxation effect due to the proximity of carbon and nitrogen atomic radius [1]. In addition to the modification of the bandstructure of graphene, nitrogen doping also modifies the properties of graphene at the atomic scale, which plays the role in interfacial effects. Using low temperature scanning tunneling microscopy (STM) combined with ab initio calculations, the interaction of nitrogen doped graphene with organic molecules has been investigated. The comparison of the spectroscopy of molecules on graphene and on a metallic Au(111) substrate allows to evidence a weak interaction of molecules on graphene. On doped graphene, the local interaction at nitrogen site induce a shift in the spectroscopy of a molecule indicative of a fractional charge transfer [2]. This effect can be exploited to tune the molecular levels of a molecule adsorbed on graphene. This is opening a new strategy to study the effect of energy position of molecular states on various phenomena. This approach has been used to identify the excitation mechanism of hydrogen transfer (tautomerization) in free base porphyrin ($H_2$TPP) molecules (Figure) allowing to control their tautomeric state and store an artificial pattern in a molecular monolayer [3].

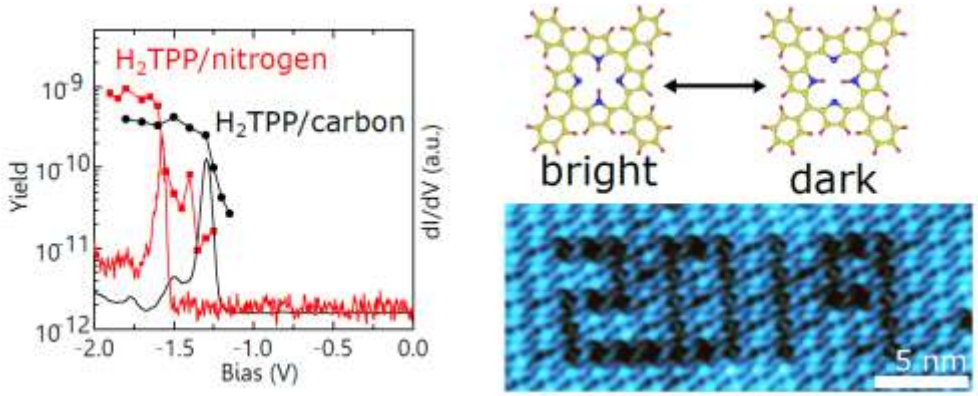


**Figure: dI/dV spectra and tautomerisation yield for $H_2$TPP molecules on pristine and doped graphene. Artificial pattern written in a monolayer of $H_2$TPP by controlling the tautomerization state of each molecule.**

**References:**

[1] F. Joucken, L. Henrard and J. Lagoute, Phys. Rev. Materials 3, 110301 (2019)
[2] V. D. Pham et al., npj 2D Materials and Applications 3, 5 (2019)
[3] R. Harsh et al., J. Phys. Chem. Lett. 10, 6897 (2019)