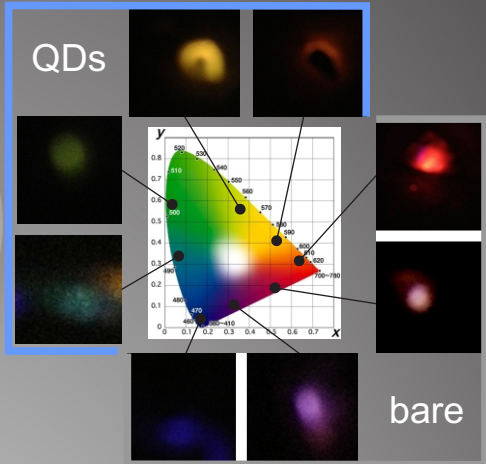


# An arbitrary color light emitter

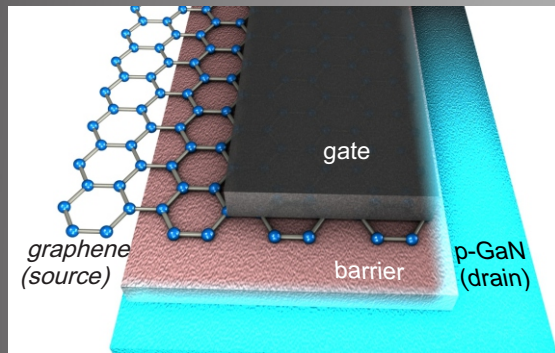
W.-C. Tan, Y.-C. Chen, Y.-R. Liou, H.-W. Hu, M. Hofmann, and Y.-F. Chen  
 Advanced Materials, vol. 29, pp. 1604076

## A color changing LED

We here report a novel light emitting transistor whose color can be changed over the whole chromaticity space which means we can achieve any color with a single emitter. This development could impart displays and lamps with new functions and higher complexity.



Photos of emission colors from a single emitter



Schematic of heterojunction device structure

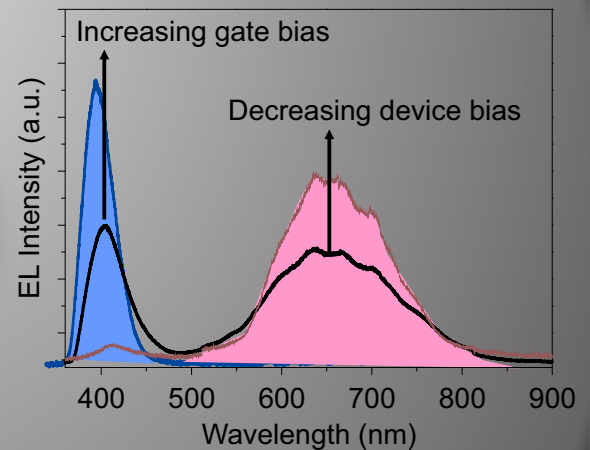


## 2D heterojunctions shine bright

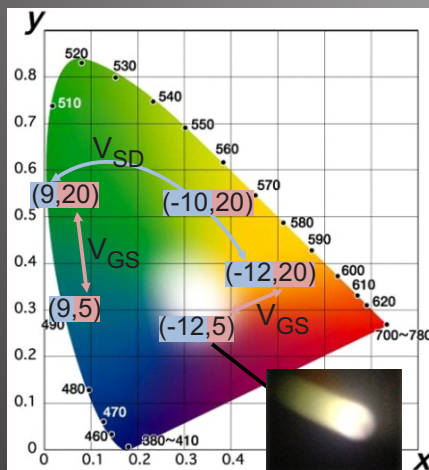
This new behavior arises from special processes occurring in junctions of ultra-thin materials. Different from traditional pn-junctions our device operates by tunneling injection of electrons from a layer of graphene into a semiconductor and subsequent stable and efficient light emission.

## Modifying the emission

The unique properties of graphene enable a new light emitting transistor where applying a reverse bias was found to enhance tunneling injection into deep acceptor states that turns the emission orange. Gating through a third terminal could selectively block band gap emission and produces blue light.



Change in emission spectrum under gating and biasing



Combinations of bias and gating access the whole color space including white (inset).



## Covering the color space

Using a down-converting Quantum dot emission layer we can adjust the emission spectrum to cover the whole color space. The independent control over device bias and gate bias can then be used to produce light emission with any color, even white light emission - a focus of LED research.

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