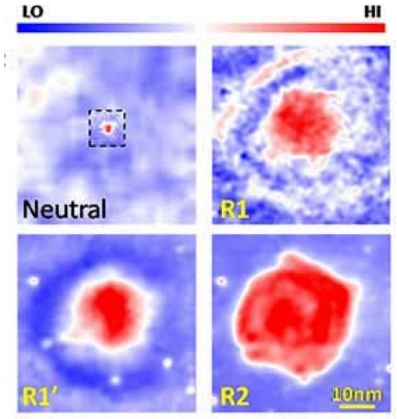
Posted: Apr 20, 2017

Creation of artificial atoms in graphene

(*Nanowerk News*) For the first time, scientists created a tunable artificial atom in graphene. They demonstrated that a vacancy in graphene can be charged in a controllable way such that electrons can be localized to mimic the electron orbitals of an artificial atom.

Importantly, the trapping mechanism is reversible (turned on and off) and the energy levels can be tuned (*Nature Physics*, "Realization of a tunable artificial atom at a charged vacancy in graphene").



Starting with a missing atom, referred to as a vacancy (top left), and applying an electric charge that attracts electrons to the region, the electrons are confined into "orbitals" to create an "artificial atom" (lower right). The images are electron concentration maps obtained with scanning tunneling spectroscopy that visualize the vacancy, and then the electron orbitals (in red) of an artificial atom created in graphene. R1, R1' and R2 show the orbitals in order of increasing energy. (Image: Eva Andrei, Rutgers University)

The results from this research demonstrate a viable, controllable, and reversible technique to confine electrons in graphene. The energy states of the electrons are 'tunable'. This tunability opens new avenues of research into the unique physics electron behavior in graphene.

Further, it provides a methodology that could facilitate the use of graphene-based devices for future electronics, communications, and sensors.

Graphene's remarkable electronic properties have fueled the vision of developing graphene-based devices to enable lighter, faster and smarter electronics and advanced computing applications.

But progress towards this goal has been slowed by the inability to confine its charge carriers with applied voltage.

A team led by researchers from Rutgers University developed a technique to stably host and controllably modify localized charge states in graphene.

The researchers created vacancies (missing carbon atoms) in the graphene lattice, by bombarding the sample with charged helium atoms (He+ ions).

They demonstrated that it is possible to deposit a positive charge at the vacancy site and to charge it gradually by applying voltage pulses with a scanning tunneling microscope tip.

As the charge on the vacancy increases, its interaction with the conduction electrons in graphene undergoes a transition. The interaction turns into a regime where the electrons can be trapped into quasi-bound energy states that resemble an artificial atom.

The team further showed that the quasi-bound states at the vacancy site are tunable with application of an external electric field. The trapping mechanism can be turned on and off, providing a new paradigm to control and guide electrons in graphene.

Source: *U.S. Department of Energy, Office of Science*

These articles might interest you as well:

Research News
(click here for Business News)

Nanoparticles - Accounting for the 'scooching effect'New device could turn heat energy into a viable fuel sourceInsect eyes inspire new solar cell design
Posted: Aug 31, 2017 Posted: Aug 31, 2017 Posted: Aug 31, 2017

New X-ray laser technique reveals magnetic skyrmion fluctuationsBeating the heat with nanoparticle filmsControlling traffic on the graphene electron highway
Posted: Aug 31, 2017 Posted: Aug 31, 2017 Posted: Aug 31, 2017
Tweaking thermoelectric voltage across atomic-scale gold junction by mechanical forceSharks with frickin' lasers: Gold nanoparticles fry cancer on glowing miceGood as gold
Posted: Aug 31, 2017 Posted: Aug 31, 2017 Posted: Aug 31, 2017
Nanocomposite sets new bar for water-splitting, CO2-splitting techniquesEnvironmental chemist flashes warning light on new nanoparticle
Posted: Aug 30, 2017 Posted: Aug 30, 2017
Toward a smart graphene membrane to desalinate waterMotorized molecules drill through cellsActing like a muscle, nano-sized device lifts 165 times its own weight
Posted: Aug 30, 2017 Posted: Aug 30, 2017 Posted: Aug 30, 2017
Lithium-ion batteries will get more efficiency due to silicon, germanium, carbon nanowallsSilicon solves problems for next-generation battery technology
Posted: Aug 30, 2017 Posted: Aug 30, 2017
Two for the price of one: Exceeding 100 percent efficiency in solar fuel productionNew mini mass spectrometer has massive implications
Posted: Aug 30, 2017 Posted: Aug 30, 2017
Biosensor could help diagnose illnesses directly in serumThe tricky trifecta of solar cells
Posted: Aug 30, 2017 Posted: Aug 30, 2017
Nanophotonic chip system measures light from a single bacterial cell to enable portable chemical detectionNanoparticles loaded with mRNA give disease-fighting properties to cells
Posted: Aug 30, 2017 Posted: Aug 30, 2017
Tracking the environmental exposure of the emerging nanomaterial industryWhy does rubbing a balloon on your hair make it stick?
Posted: Aug 30, 2017 Posted: Aug 29, 2017
Photosynthesis discovery could lead to design of more efficient artificial solar cells
Posted: Aug 29, 2017

...MORE NANOTECHNOLOGY RESEARCH NEWS