Nonlinear Plasmonic Sensing with Nanographene

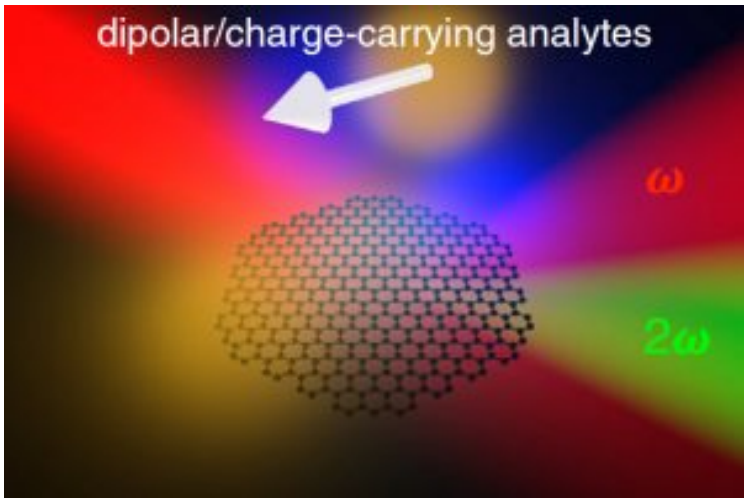

Illustration of an armchair-edged graphene nanohexagon (GNH) interacting with a charge- or dipole-carrying analyte (the white arrow indicates a permanent dipole moment). The molecule induces asymmetry in the nanohexagon conduction electron distribution, which can be detected by measuring either changes in the optical absorption spectrum or the onset of a second-harmonic signal.

Plasmons provide excellent sensitivity to detect analyte molecules through their strong interaction with the dielectric environment. Plasmonic sensors based on noble metals are, however, limited by the spectral broadening of these excitations. Yu and his colleagues identify a new mechanism that reveals the presence of individual molecules through the radical changes that they produce in the plasmons of graphene nanoislands. An elementary charge or a weak permanent dipole

carried by the molecule are shown to be sufficient to trigger observable modifications in the linear absorption spectra and the nonlinear response of the nanoislands. In particular, a strong second-harmonic signal, forbidden by symmetry in the unexposed graphene nanostructure, emerges due to a redistribution of conduction electrons produced by interaction with the molecule. These results pave the way toward ultrasensitive nonlinear detection of dipolar molecules and molecular radicals that is made possible by the extraordinary optoelectronic properties of graphene.

Source: http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.117.123904