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Abstract— Graphene opens up for novel optoelectronic applications thanks to its high carrier mobility, ultra-large absorption bandwidth, and extremely fast material response. In particular, the opportunity to control optoelectronic properties through Fermi-level tuning enables electro-optical modulation, optical-optical switching, and other optoelectronics applications. Except for the statistic gating and chemical doping, the Fermi level of graphene can also be optically tuned. With the aid of external optical pumping, electrons can be excited in the substrate, then move to the graphene layer, leading to the electrical doping in graphene. In this talk, I will firstly discuss how the graphene property changes when applying the optical pumping with different incident power. Then I will discuss graphene-silicon microring devices with having a high modulation depth and with a relatively low bias voltage. Finally, I will discuss a novel hybrid graphene-metal system for studying light-matter interactions with gold-void nanostructures exhibiting resonances in the visible range. The hybrid system is further explored for sensing of Rhodamine 6G molecules with respect to the strong surface-enhanced Raman scattering.