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Designing light matter coupling in nanocrystal array used for infrared sensing

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Nanocrystals are one of the few exemple of nanomaterials to have reached a mass market with their use as green and red source in display. Interest for their infrared properties have first been driven by solar cell, but currently this is th ease to shift their absorbance further in the infrared that focus the interest for this class of material. In the introduction, i will first review some recent developments relative to HgTe nanocrystals [1] from their synthesis to their device integration including infrared LED [2] and focal plane array for imaging.

One key issue raised by the use of nanocrystal for photoconduction is the discrepency between the absorption depth (few µm) and the charge diffusion length (<100 nm). In other word, thick samples are desirable to absorb photon, but photocarrier collection remains limited. To overcome issue, we introduce sub wavelength resonator which role is to « focus » the light onto a thin slab of semiconductor (<200 nm) [3-4]. Such device are able to achieve broadband absorption (≈80 % of incident light) in the short wave infrared.

[1] C Gréboval et al, Chem. Rev. 121, 3627(2021)
[2] J Qu et al, Nano Lett. 20, 6185 (2020)
[3] P Rastogi et al, Adv. Opt. Mat., 2002066 (2021)
[4] A Chu et al, ACS Photonics 6, 2553 (2019)