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Laser cooling of phonons in semiconductors

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Last century has witnessed a tremendous success of laser cooling technology in the fields of precision spectroscopy, time and frequency metrology, quantum optics, and solid-state optical refrigeration. Here i will report our results on laser cooling of phonons in semiconductors. By using of strong coupling between excitons and longitudinal optical phonons (LOPs), which allows the resonant annihilation of multiple LOPs in luminescence up-conversion processes, we observe a net cooling by about 40 K starting from 290 kelvin CdS. We also discuss the thickness dependence of laser cooing in CdS nanobelts, possibility of laser cooling in II-VI semiconductor family including CdSSe CdSe and bulk CdS *et al*., Beyond II-VI semiconductor, I will present our recent progress in laser cooling of organic-inorganic perovskite materials, which show a very big cooling power and external quantum efficiency in 3D and 2D case. Furthermore, I will show a sideband Raman cooling and heating experiments of longitudinal optical phonon (LOP) with a 6.23 THz frequency in semiconductor zinc telluride nano-ribbons. When we use red-sideband laser to pump the nanoribbon, the LOP can be cooled from 225 to 165 kelvin. We also observe a LOPs heating behavior from 230 to 326 kelvin with a blue-sideband pumping.

References

[1] J. Zhang *et al*., *Nature* (cover) 493, 504-508 (2013)
[2] D. H. Li*, J. Zhang* *et al*., *Optics Express,* 21, 19302-19310 (2013)
[3] D. H. Li*, J. Zhang* *et al*., *Nano Letters* 14, 4724 4728 (2014)
[4] S. T. Ha & J. Zhang *et al*., *Nature Photonics*, 10, 115-121(2016)
[5] J. Zhang *et al*., *Nature Photonics*, 10, 600-605 (2016)

ye_yu

Photograph by Xiaodong Hu