双曲声子极化激元的禁向传播及在近场能量输运中的应用

DOI: 10.12086/oee.2024.241010.h03

可调谐的声子极化激元的纳米结构的加工困难、损耗增加，扭转限制单层材料的应用，因此探索更多的调控手段对于操控声子极化激元的激发和传播具有不可忽略意义。

清华大学曹良才教授和南非威特沃特斯兰德大学 Andrew 山东高等技术研究院吴小虎研究员联合北京大学符策基副教授团队提出了借助衬底的接触驱动 vdW 材料 (三氧化钼，α-MoO_3) 内极化激元传播的策略，使得声子极化激元传播方向发生 90°偏转，从而实现沿着激元的禁向传播。同时，阐述了衬底依赖的极化激元耦合在近场热辐射所起的作用，间距与平板厚度的相互关系对辐射换热的影响。

依赖衬底的激元应用在辐射换热中，研究 SiC 和 Au 基底对两块 α-MoO_3 平板之间的近场换热的影响并与无基底的情况进行比较。结果发现，SiC 基底增强还是抑制辐射取决于 α-MoO_3 平板的厚度与真空间距的相对大小。当平板厚度一定时，改变真空间距，依据 SiC 的效果，可以将整个间距变化区间从左到右划分为几乎不起作用区域，抑制区间，还有增强区间。这是由于当真空间距比平板的厚度小时，平板激发的激元的相互耦合的波矢区域与无限大平板相差不大，导致此时的平板可以等效为体材料，因此基底就对能量传输不起作用。

Opto-Electronic Science, 2024, **3**(6): 240002.
https://www.oejournal.org/article/doi/10.29026/oes.2024.240002.

The forbidden propagation of hyperbolic phonon polaritons and applications in near-field energy transport

DOI: 10.12086/oee.2024.241010.h03

Currently available tuning strategies for phonon polaritons are mostly limited to the construction of nano-patterned structures on the vdW material itself, where the nanostructures increase losses, so exploring more modulation methods is of non-negligible significance to manipulate the excitation and propagation of phonon polaritons.

The research group of Prof. Xiaohu Wu from Shandong Institute of Advanced Technology, together with the team of Prof. Ceji Fu from Peking University, propose a strategy to drive the phonon polaritons propagation in vdW material (molybdenum trioxide, α-MoO_3) with the help of the substrate, so that the direction of the propagation direction of hyperbolic phonon polaritons can be reoriented by 90°to achieve the forbidden propagation. At the same time, the role of substrate-dependent phonon polaritons coupling in near-field thermal radiation is described and the influence of the correlation between width of air spacing and thickness of α-MoO_3 slab on the radiative heat transfer is investigated.

It is found that whether the SiC substrate enhances or suppresses the radiation depends on the relative amplitude of thickness of the α-MoO_3 slab and the width of air spacing. When the vacuum width varies, the whole region can be divided into a nearly inactive region, an inhibition region, and an enhancement region from left to right based on the effect of SiC. This is due to the fact that when the spatial distance is smaller than the thickness of the slab, the wavevector region of the mutual coupling of the excited polaritons of the slab does not differ much from that of the infinite bulk, resulting in a slab that can be equivalently treated as a bulk material at this point in time, and thus the substrate is not effective for energy transfer.

Opto-Electronic Science, 2024, **3**(6): 240002.
https://www.oejournal.org/article/doi/10.29026/oes.2024.240002.