耐熱プラズモン材料としての六ホウ化ランタンを用いた赤外光源
Robust Infrared Thermal Emitters Based on Epitaxial LaB_6 Films for Infrared Plasmon Photonics

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For high performance infrared (IR) devices, such as molecular sensors or thermal emitters, having robust low-loss plasmonic materials is crucial. Conventional plasmonic materials, such as Au, Ag, Al, and Cu, have been heavily utilized owing to their excellent optical properties in the UV-Vis region. In the IR region, the optical loss of these materials becomes too high, and the performence degrades. However, compound materials such as transparent conductive oxides, nitrides, or borides can have low-loss and plasmonic characteristics at longer wavelengths. In the context of high-temperature IR plasmonic applications, these materials also endure elevated temperatures due to their high melting points. From the boride compounds, lanthanum hexaboride (LaB_6) is an attractive boron compound, known for its low work function and superior thermionic emission [1,2]. LaB_6 is a conductive ceramic with robust chemical stability, and can achieve a melting point around ~2500°C. This makes it a superb choice for IR plasmonics and thermal emitters, especially to overcome the challenge with being stable at elevated temperatures to maintain its performance. In this report, using electron beam evaporation (EBE), high-quality epitaxial thin films of LaB_6(001) were achieved, deposited directly on Si(001). Crystal film is subjected to less strain, as confirmed from Raman shifts, and exhibited low-loss nature in the near IR region, making them promising for IR nanophotonics, plasmonics and high-temperature devices [3,4]. We fabricated Gires-Tournois-based thermal emitter and demonstrated narrowband thermal emission with bandwidth smaller than 100 nm at operation temperatures above 1200°C.

References:
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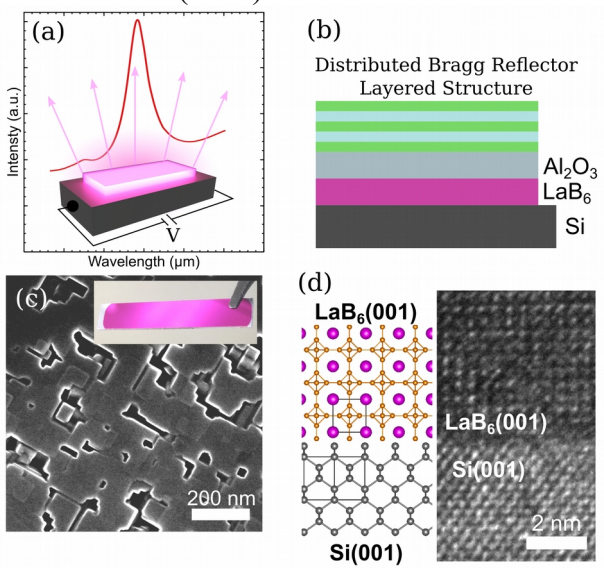

Figure. (a) LaB6 based thermal emitter with narrow emission spectrum. (b) A selective thermal emitter device structure. (c) SEM image of LaB6 film. (d) Cross section TEM image at interface between LaB_6 and Si.