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New type Anti-Stokes laser cooling materials: $Yb:LiLuF_4$ crystal

Jigang Yin[a], ,Lianhan Zhang[a], Guangzhu Chen[a], Kaijie Ning[a], Peixiong Zhang[a,b], Zhe Chen[a,b], Xiangyong Wang[a,b], Yin Hang[a*]

[a] *Key Laboratory of High Power Laser Materials, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai 201800, PR China*

[b] *Graduate School of Chinese Academy of Sciences, Beijing 100039, PR China*

[*] *Corresponding author: yhang@siom.ac.cn. yjg@siom.ac.cn*

Abstract:

Optical irradiation accompanied by spontaneous anti-Stokes emission can lead to cooling of matter, in a phenomenon known as laser cooling, or optical refrigeration, which was proposed by Pringsheim in 1929. Recently, cooling of a high-density gas through collision redistribution of radiation has been demonstrated. In laser cooling of solids, heat is removed through the annihilation of lattice vibrations in the process of anti-Stokes fluorescence. Since its initial observation in 1995, research has led to achieving a temperature of 208 K in ytterbium-doped glass. In this Letter, we report Anti- Stokes laser cooling in ytterbium-doped $LiLuF_4$ single crystals grown using the Czochralski technique. The spectroscopic characterization of the crystals has been used to evaluate the laser cooling performance of the samples. Cooling by 6 degrees below ambient temperature is obtained.

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