MgO 立方体結晶からの室温紫外レーザー発振

Ultraviolet stimulated emission from cubic MgO microcrystals

相馬遥香 [1]、上中友紀 [1]，浅原彰文 [2]，末元徹 [2]，○内野隆司 [1]（1. 神戸大、2. 東大物性研）

Haruka Soma,[1] Yuki Uenaka,[1] Akifumi Asahara,[2] Tohru Suemoto,[2] and ○Takashi Uchino[1] (1.Kobe Univ., 2.Tokyo Univ.)

E-mail: uchino@kobe-u.ac.jp

Ever since the report of room temperature laser emission from ZnO thin films and nanowires under optical pumping, semiconductor nanostructure lasers have attracted intense interest as promising ultracompact and low power consumption photonic lasers. In contrast to the case of semiconductors, optically pumped band-edge lasing is difficult to achieve in insulating oxides with large band gap energy *E*g (e.g. *E*g > ~6 eV) because of the unavailability of the pumping source, even when the nano/microstructures appropriate for lasing are possible to fabricate. In this work, we show that the MgO microcrystals exhibit an intriguing lasing behavior when the samples are annealed in air atmosphere at temperatures of 1000 °C and above.

Our SEM and XRD data show that well-crystallized MgO microcrystals with the size of ~1–3 μm are prepared by solid phase reaction between Mg and B2O3 under Ar atmosphere, combined with post annealing in air (Figure 1). Room-temperature lasing action at 394 nm was demonstrated from the well-annealed MgO microcrystals under pulsed laser excitation with wavelength of ~350 nm (Figure 2). Surface emission centers associated with hydroxylated species at the edges and corners of the microcrystals are expected to be responsible for the 394-nm laser emission. The natural optical cavity derived from the facets of the microcrystals or recurrent light scattering among the microcrystals is responsible for the coherent feedback. It should also be noted that he observed lasing threshold under ~10 nanosecond pulsed laser excitation is ~20 mJ/cm^2 per pulse (or ~200 kW/cm^2), which is comparable to the typical values of lasing threshold observed for semiconductor nanowire lasers under similar excitation conditions. The present observation will hence provide a solid-state system that allows light amplification by changing the scale and surface states of otherwise optically inert insulating oxides.

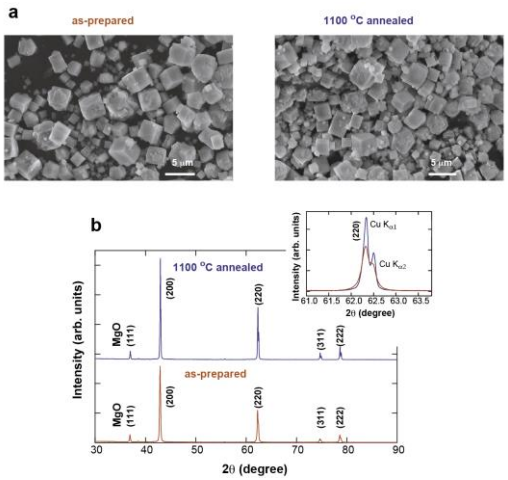

Figure 1. Structural characterization of the MgO microcrystals. **(a)** Scanning electron microscopy images and **(b)** X-ray diffraction patterns of the as-prepared and 1100-°C annealed MgO samples. The inset in **(b)** shows an enlarged plot of the (220) Bragg peaks.

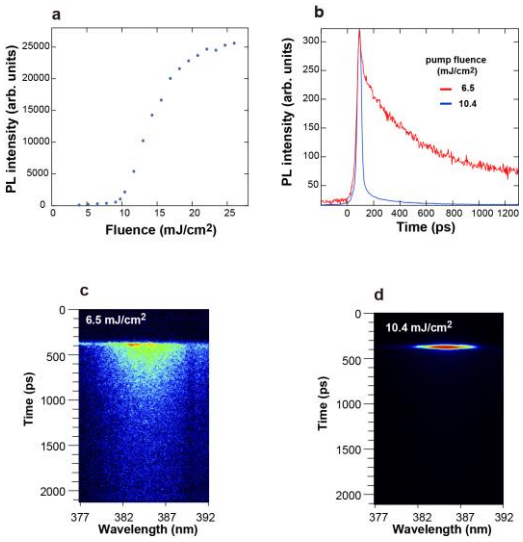

Figure 2. PL characteristics of the 1100-°C annealed MgO microcrystals obtained under femtosecond pulsed laser excitation at 350 nm. **(a)** Emission peak intensity as a function of pump fluence. **(b)** Normalized decay profiles of the emission recorded at different pump fluences. **(c), (d)** Streak-camera images obtained under the designated pump fluences.