

Title- Single Visit Research Subject. Development of transparent ceramics superior to single crystal for high power laser application

Introductory part- I have continued on February 11-March 3, 2013 my fruitful cooperation with Pr. Yoshikawa and Pr. Goto Labs on Nd³⁺-doped Lu₂O₃ ceramics made by SPS method. I also have attended ELYT Workshop 2013 at Zao Mountains and visited Dr. A. Ikesue inside the Japan Fine Ceramics Center of Nagoya.

After my recent stay at ICC-IMR on November-December 2012, I got again the great privilege to be helped by ICC-IMR to continue my fruitful cooperation at the Tohoku University between February 11 and March 3.

The first objective of my stay at IMR has been to show to Prof. Yoshikawa and Prof. Goto our new results of the spectroscopic measurements on Nd³⁺:Lu₂O₃ transparent laser ceramics obtained for the first time by the non-conventional spark plasma sintering (SPS) method [1]. Absorption spectra have been analyzed at room temperature and at 4K at the Faculty of Chemistry of Wroclaw (Poland) by Dr.M. Guzik. Especially at 4K this fine spectroscopy shows not only Nd³⁺ C₂ usual isolated ions but also the signatures of C₂-C₂ and C₂-C_{3i} Nd³⁺ pairs and even of the weak populated C_{3i} isolated sites. Emission spectra of the expected laser lines $^4F_{3/2} \rightarrow ^4I_{11/2}$, at both 1076.4 nm and 1080.5 nm and concentration dependence of the $^4F_{3/2}$ decays have also been analyzed at Lyon. The most striking feature is a strong concentration quenching seen in Fig.1 above 0.1% Nd³⁺, a weak value for laser material, so that laser output will need a sharp optimization to be pointed out.

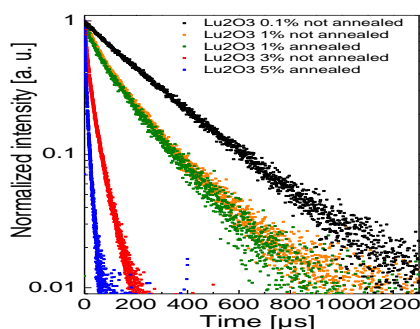


Fig.1 Decays of the Nd³⁺ $^4F_{3/2}$ meta-stable level at room temperature for several Nd³⁺ concentrations.

At last, we use these samples to bring more knowledge on Nd³⁺ isolated and pair sites by application of the site selective laser spectroscopy technique not only on Nd³⁺ C₂ populated sites but also on less populated C_{3i} inversion sites. In addition we have detected

Nd³⁺ C₂-Nd³⁺ C₂ and Nd³⁺ C₂-Nd³⁺ C_{3i} pairs, respectively.

During this stay Dr. A. Ito has measured the values of the thermal conductivity, Dr. T. Ito and Prof. Kikuchi have started to register the TEM-EDX photos for the evaluation of Nd³⁺ segregation in grains and grain boundaries.

It was also a great opportunity to attend the successful ELYT Workshop 2013 at hotel Laforet Zao To-o-gatta, February 17-20, 2013, organized by the new Associated International Laboratory (LIA in French) of "Engineering Science Lyon-Tohoku Laboratory", ELYT Lab. for the period 2013-2018. My oral communication gave the objectives of our project ELYT lab, M12- LASMAT, on "Rare earth-doped transparent laser ceramics by SPS method".

Then, I have visited the Laboratory of Dr. Akio Ikesue, World-Labo Co, Ltd, inside Japan Fine Ceramics Center in Nagoya on 24-26 February. Dr. Akio Ikesue also works on Nd³⁺:Lu₂O₃ and Nd³⁺:Y₂O₃ ceramics but made by conventional methods and has proposed me these samples to compare with ours obtained by SPS method.

At last, we have submitted two abstracts for SCINT2013 and REMAT2013 International Conferences [2-3].

References

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- [2] Shunsuke Kurosawa, Akihiro Yamaji, Akira Suzuki, Yuui Yokota, Kenji Shirasaki, Yamamura Tomoo, Akihiko Ito, Takashi Goto, Georges Boulon, Akira Yoshikawa-Scintillation Properties of Nd³⁺-doped Lu₂O₃ Transparent Ceramic in the Infra-Red Region. 12th International Conference on Inorganic Scintillators and their Applications (SCINT) 2013). April 15-19, 2013, Shanghai (China)
- [3] G. Boulon, G. Alombert-Guget, Y. Guyot, A. Brenier, M. Guzik, T. Goto, A. Yoshikawa Nd³⁺-Doped Lu₂O₃ transparent ceramic elaborated by Spark Plasma Sintering method: spectroscopic and structural characterizations. Invited paper at the 3rd International Conference on Rare earth Materials (REMAT 2013). April 26-28, 2013, Wroclaw (Poland).

Keywords: Ceramic, optical properties, laser,

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