☐ Oral Presentation ☒ Poster

TRANSPARENT CERAMICS FOR HIGH POWER LASER APPLICATIONS

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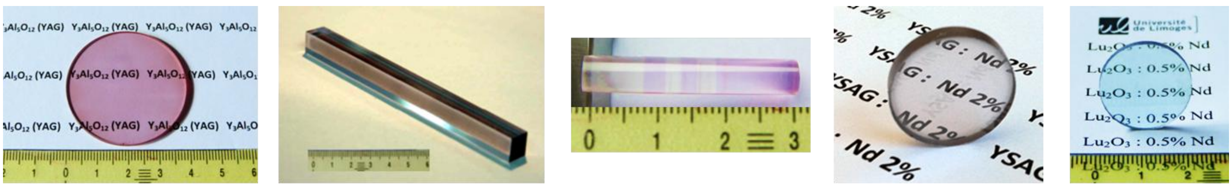
Transparent ceramics show interesting optical and luminescent properties thus can be used as laser gain media. These materials can incorporate high amounts of luminescent dopant and can be manufactured in the form of large pieces in relatively limited short time with limited synthesis temperature[1]. Ceramics are thus an interesting alternative to melt-grown single-crystals the manufacturing of which requires generally more drastic synthesis conditions. For high power and/or energy laser applications, rare-earth synthetic garnets (*e.g.* Nd:$Y_3Al_5O_{12}$, Yb:$Lu_3Al_5O_{12}$…) or sesquioxides (*e.g.* Yb:Lu_2O_3, Yb:Y_2O_3…) have numerous advantages such as high thermal conductivity (> 8 $W.m^{-1}.K^{-1}$), high thermal shock resistance (> 5 $W.m^{-1/2}$)and high laser efficiency (laser slope efficiency > 30%). The improvement of the thermo-optical efficiency needs to manufacture new laser gain media architectures in the form of dopant gradient, clad-core or multilayer [2]. On the contrary, single-crystal technology remains limited because of cost-consuming and non-defect-free processes like diffusion bonding.

Theprevious works which are performed at SPCTS-LCTL (Joint CILAS/SPCTS Laboratory for Laser Transparent Ceramics) consisted in developing new laser optical components for lasers (see Figure 1), especially amplifier media or Q-switch components with complex architectures for high power lasers. We have investigated many oxide ceramic matrix systems doped with luminescent rare-earth (Yb, Nd, Ho, etc.) like YAG[3], YSAG[4], LuAG[5]or Lu_2O_3[6]. The implementation of new shaping and sintering processes allows to manufacture "composite" materials with original shapes and/or composition/dopant gradients. As examples, versatile shaping techniques of powders in suspension like slip-casting or tape-casting were demonstrated to be well adapted to manufacture clad-core or multilayer optical components[5]. The use of new pressure- and current-assisted sintering techniques like SPS (Spark Plasma Sintering) have been also carried out to drastically reduce sintering time (*i.e.* only 1 h) compared to conventional pressure-less sintering techniques (more than 24 h). Finally, these components were integrated in laser cavity. As an example, 1at.%Nd:YAG ceramics developed at LCTL have demonstrated high efficiency for large pieces (*i.e.* ≥ 33% for 40x8 mm discs).



(a) (b) (c) (d) (e)

Figure 1: Laser transparent ceramics developed at LCTL: Nd:YAG discs (a) or slab (b), YAG/Nd:YAGmultilayer barrel (6 layers) (c), Nd:YSAG (d), Nd:Lu_2O_3 (e).

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