# EQUATION OF STATE AND PRESSURE DEPENDENCE OF LATTICE PARAMETER OF GADOLINIUM GALLIUM GARNET CRYSTALS

A. Durygin[1], W. Paszkowicz[2], R. Buczko[2], A. Kaminska[2], S. Saxena[1], A. Suchocki[2,3]

[1] - CeSMEC, Florida International University, University Park, Miami, FL, USA
[2] Institute of Physics, Polish Academy of Sciences, Warsaw, Poland
[3] Institute of Physics, University of Bydgoszcz, Bydgoszcz, Poland

Gadolinium Gallium Garnet (GGG) crystals serve as a lasing host material for various dopants. Among them $Yb^{3+}$ ion is nowadays attracting a lot of attention showing laser action at a wavelength of about $1\,\mu m$ with the possibility of tuning and also a self-frequency doubling in some hosts. It has been shown that GGG:Yb laser crystals can be diode pumped. GGG crystals can be easily produced using various methods as well as very convenient for research the micro-pulling down method.

GGG crystals posses *Ia3d* space group. Rare-earth ions in these crystals substitute $Ga^{3+}$ in dodecahedral positions. The point symmetry of this site is $D_2$. Under influence of hydrostatic pressure the point symmetry of this positions seems to be increased even to $O_h$ at certain pressure and again lowered to $D_2$ at higher pressures. No phase transition is observed at this pressure. The phase transition occurs at much higher pressure of about 80 GPa. This intriguing behavior can be observed when splitting of so called R-level ($^4F_{3/2}$) of $Nd^{3+}$ ions is removed by applying pressure of about 10 GPa to GGG crystals. This phenomenon can occur only if $Nd^{3+}$ ions are located in sites with $O_h$ symmetry[1].

In this work we report synchrotron X-ray studies of crystallographic structure of GGG crystals under hydrostatic pressure up to 25 GPa at room temperature in diamond-anvil cell. Hydrostatic conditions were well preserved at least up to 10 GPa. The measured pressure dependence of lattice parameter is compared with theoretical *ab initio* calculations and available theoretical estimations of bulk modulus and its pressure derivative for GGG crystals [2,3]. The experimental results confirm earlier theoretical estimations that the GGG crystal has the smallest bulk modulus among several other garnets containing Gd and Ga ions. The theory also shows that at certain pressure the Ga in dodecahedral site – O distances are equal.

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