HC PHOTONICS CORP.

Tel: +886-3-6662123
www.hcphotonics.com
service@hcphotonics.com

Normalized efficiency

Q: What is SHG normalized efficiency and how does it vary with pump wavelength?

A:

Optimal focusing condition:

For a specified chip length *L*, the optimal focusing condition to achieve the highest conversion efficiency is shown below:

$$\frac{L}{b} \sim 2.84,\ b = \frac{n\pi w_0^2}{\lambda},$$

where w_0 is the focused beam waist radius of the pump beam, λ is the pump wavelength and n in the refractive index of the PPLN at the fundamental wavelength.

Normalized conversion efficiency:

Under the optimal focusing condition, the SHG conversion efficiency could be represented by the equation below

$$\eta(\lambda) \sim 1.068 \frac{16\pi^2 d_{eff}^2 L}{n^2 \varepsilon_0 c_0^2 \lambda^3} P_{in},$$

where d_{eff} is the effective nonlinear coefficient with taking periodical poling into account, and usually estimated by 14 pm/V. From the above two equations, one can have a general idea for the SHG conversion that

1. SHG conversion efficiency is proportional to $1/\lambda^3$.
2. Optimal focusing beam radius is proportional to $\lambda^{0.5}$.

Setting with P_{in} = 1W, *L*=1cm, we can come up with the result of "Normalized conversion efficiency" in unit of %/W/cm. The physical meaning is the nonlinear conversion efficiency per Watt pump power and per unit length of crystal before pump depletion, which indicates the performance of the nonlinear crystal usually. Figures below are the references for the normalized conversion efficiency and the relative optimal beam waist radius calculated according to the mentioned condition.

Tel: +886-3-6662123
www.hcphotonics.com
service@hcphotonics.com

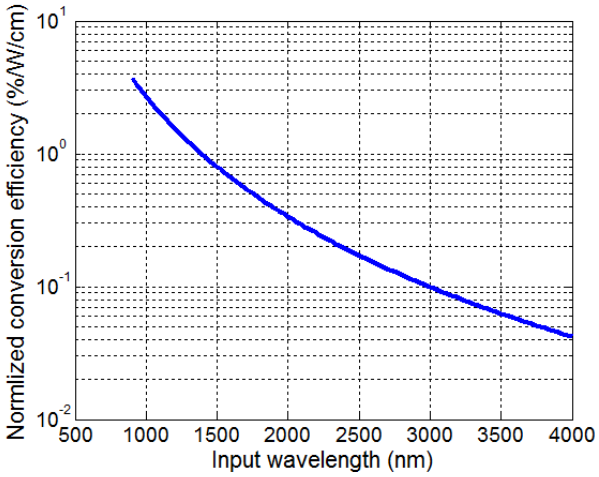

Fig. 1 Optimal SHG normalized conversion efficiency under different input wavelength.

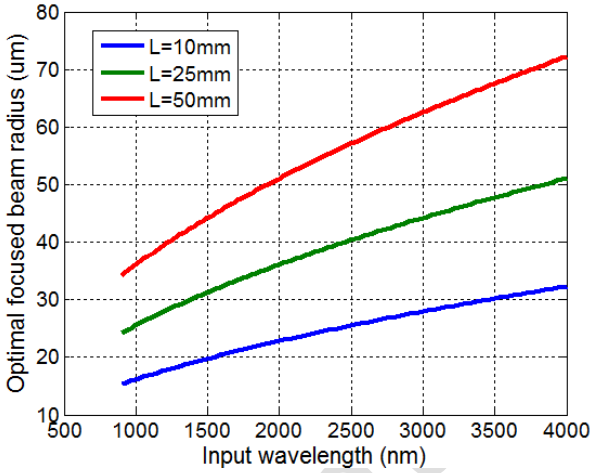

Fig. 2 Optimal focused beam radius under L=10, 25 and 50mm, respectively.

For the conditions of non-optimal focused beam size, please refer to the reference [1].

Above figures are only valid with neglectable pump depletion, and without other material degradation factors such as photo-refractive effect. For those effects of material, please refer to the FAQ session “Damage & GRIIA” for the safety concern to avoid the damage.

Reference:

[1] Parametric interaction of focused Gaussian light beams." *Journal of Applied Physics* 39.8 (1968): 3597-3639