# Development of Optical Device Housing Compacted Using SUS304L Granulated Powders

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**Abstract**

*In order to develop the SUS304L housing by powder metallurgy for an optical device useful for the FTTH communication system, the optimum compacting pressure and sintering temperature were investigated using granulated powder as the material to satisfy high air-tightness and high laser-weldability. Then the laser-welding test of specimen made under the optimum condition was carried out to observe welding sputters.*

**Keywords :** ***Optical device housing, Laser welding, Granulated powder, Air-tightness, Welding sputters***

## 1. Introduction

Stainless steel SUS304L is applied for an optical device housing [1], which is a key component of FTTH (Fiber to the home) communication system, because of its high reliability. Devices are jointed on circumferences of the holes by a laser welding. Hence it is required to be high air-tightness of He-leakage less than $10^{-9}$Pa・$m^3$/s and good laser-weldability with no sputtering for the housing.
However, there were problems not to be capable of obtaining high air-tightness and to damage the optical device by welding sputters due to low density and rough surface in case of a product made by the conventional powder metallurgy [2]. Therefore we have attempted to use granulated powder coalescing fine powder less than 10μm [3]. It is expected to make the sintered body high dense and its surface smooth.

In this paper, the optimum compacting pressure and sintering temperature were investigated to develop the optical device housing with high air-tightness using granulated powder. Then laser-welding test of specimen made under the optimum condition was carried out to confirm little welding sputters.

## 2. Experimental and Results

**Preparing process of specimens.** Material powder is granulated powder prepared by coalescing SUS304L fine powder with less than 10μm in size. The granulated powder is suitable for uniformly filling into a die because of its high fluidity. The powder was mixed with finely powdered 1 mass % wax and was compacted into a disk-like shape φ25×t3mm. The compacted specimens were de-waxed and then were sintered in hydrogen atmosphere using a pusher type Mo-heater furnace.
**Measurements.** He-leakage test was performed using He leake detector equipment.
**Laser-welding test.** Spot laser welding of specimen was carried out to observe sputters occurred during welding.
Laser welding condition is shown in Table 1.

**Table 1. Laser welding condition**

| Type | Power [W] | Frequency [Hz] | Defocus [mm] | Energy density [J/mm$^2$ ] |
|---|---|---|---|---|
| $CO_2$ | 400 | 17 | -4 | 48 |

**Air-tightness.** Fig.1 shows He-leakage of specimens sintered at 1523K after compacting in the range from 200 to 700MPa. As shown in the figure, the leakage decreases with increasing pressure and shows high air-tightness less than $10^{-9}$ Pa・$m^3$/s at the higher pressure than 400MPa.
Fig.2 shows He-leakage of specimens sintered in the range from 1373 to 1623K after compacting at 500MPa. It is clear that sintering temperature more than 1473K is appropriate for the optical device housing.
From the above results, it is concluded that the optimum condition satisfying the air-tightness for the housing is compacting pressure more than 400MPa and sintering temperature more than 1473K. We have chosen the optimum condition to be compacting pressure of 500MPa and sintering temperature 1523K which are a little higher than their lower limits based on consideration of production allowance to some extent.

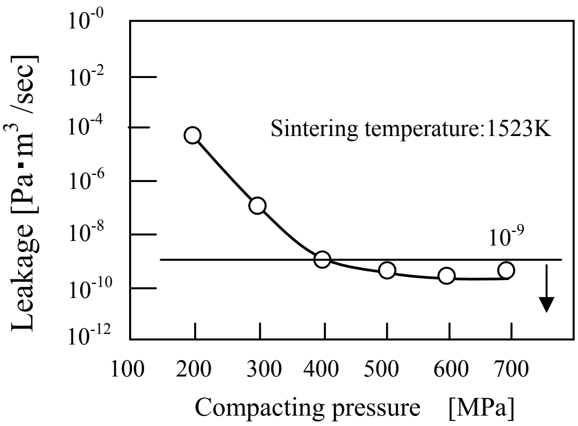



**Fig.1. Relation between compacting pressure and leakage of specimens.**

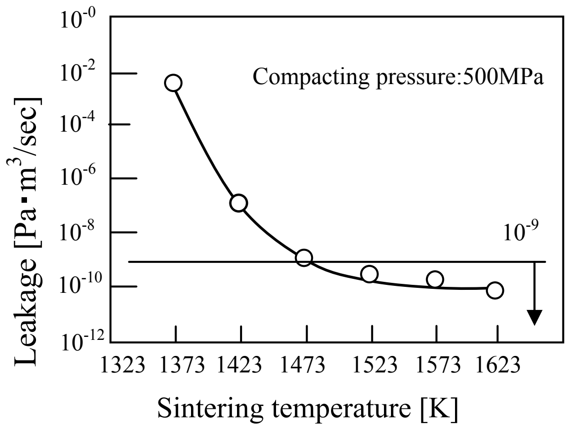
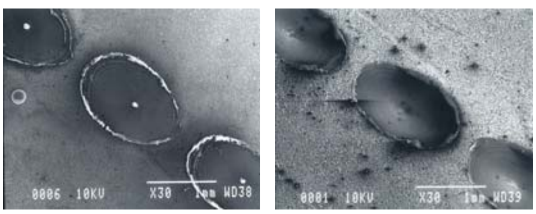



**Fig. 2 . Relation between sintering temperature and leakage of specimens.**

**Laser-welding test.** Fig.3 (a) and (b) show SEM micrographs of laser spot welded specimens sintered using granulated powder and similar specimen using conventional –100 mesh powder. As shown in the figures, sputters scattered on the circumferential area of spot welding are hardly observed in case of granulated powder, but considerably found in case of conventional powder.



Ra=0.5 μm (not irradiated area) (a) Granulated powder

Ra=1.0 μm (not irradiated area) (b) Conventional -100mesh powder

**Fig. 3. SEM image of spot irradiated areas on specimens sintered using granulated powder and conventional –100mesh powder.**

**Fig. 4. Housing parts for FTTH device.**

This attributes to the difference in surface roughness between the granulated specimen (Ra=0.5μm) and the conventional specimen (Ra=1.0μm).

**Application.** Fig.4 shows housing examples made under the condition using the granulated powder as material. The housings have been applied for the optical device useful for FTTH communication system because of its high reliability and less expensive cost.

## 3. Summary

1. It is found that the optimum compacting pressure is 500MPa and sintering temperature is 1523K to obtain the housing with high air-tightness of He-leakage less than $10^{-9}$ Pa・m$^3$/s.
2. Laser-welding test revealed that there were no sputters in the granulated powder specimen made under the optimum condition and hence there is little risk of damaging the optical device. The good laser weldability depends on its smooth surface.
3. The housing has been successfully applied to the optical device useful for FTTH system. And its manufacturing cost is about 1/2 compared with the parts machined from wrought steel.

## 4. References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