5th Asia-Pacific Conference on Plasma Physics, 26 Sept-1Oct, 2021, Remote e-conference

# Thin film formation and phenomenon of sputtering by using powder target

T. Ohshima[1,2], H. Kawasaki[1], Y. Yagyu[1], T. Ihara[1], Y. Hibino[1],
N. Itagaki[2], K. Koga[2] and M. Shiratani[2]
[1] National Institute of Technology, Sasebo College, [2] Graduate School and Faculty of Information Science and Electrical Engineering, Kyushu University
e-mail (speaker): ohshima@sasebo.ac.jp

In conventional sputtering method, high density bulk targets are used as the base materials for the thin films. Bulk targets are made by baking raw powders at high temperature and high pressure. However, commercially available bulk targets are generally expensive. Each time the composition of the bulk target is changed, the new target is required, resulting in high cost. Therefore, we attempt to reduce the fabrication cost of multi-element composite thin films by using powder targets instead of bulk targets. On the other hands, there are few reports about the fabrication of thin films deposited using powder targets by sputtering method.[1,2]

This work fabricates Al doped zinc oxide (AZO) thin films, that is an attractive candidate for transparent conducting oxides (TCOs) instead of indium tin oxide (ITO), by using mixed powders of zinc oxide (ZnO) and aluminum oxide ($Al_2O_3$). AZO thin films have been prepared at deposition conditions as shown in Fig. 1(b) by further changing the deposition time and the frequency of powder exchange. Figures 1(c)-(f) show the measurement results about crystallinity, deposition rate, optical transmittance and resistivity of the prepared AZO thin films. We have revealed that the relationship between the change over time of the powder target and the film properties.

This work is supported by KAKENHI 20K03921.

References

[1] S.H. Seo *et al*, Thin Solid Films **518**, 5164 (2010)
[2] T. Ohshima *et al*, Jpn. J. Appl. Phys., **55**(1S), 01AA08 (2016)

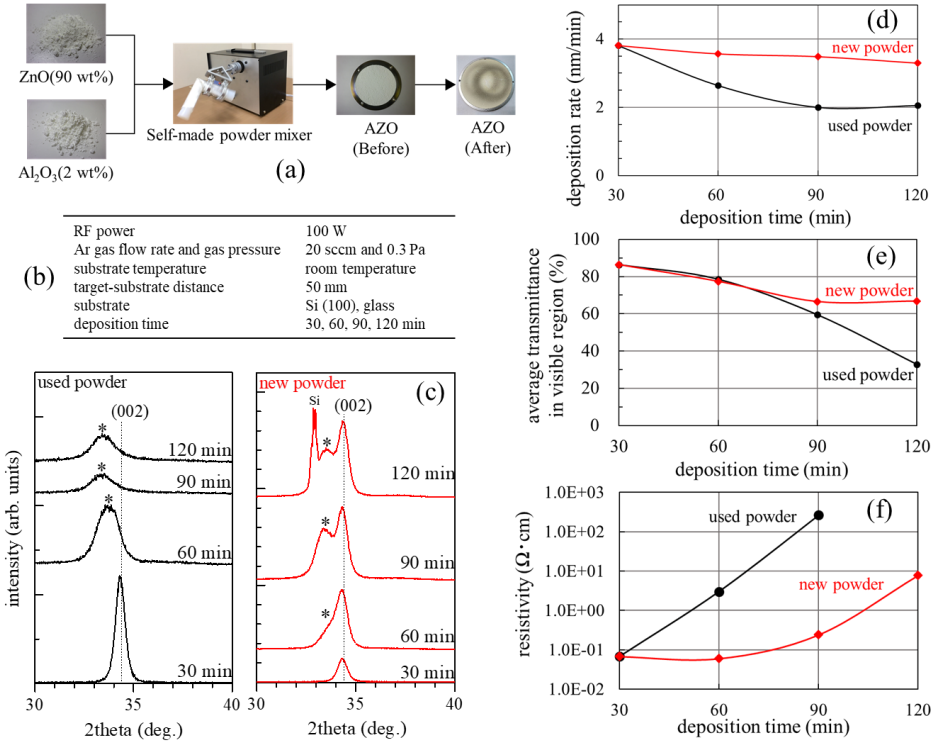


**Figure 1.** (a) How to make a mixed powder target and (b) deposition conditions of AZO thin films. The measurement results of (c) XRD, (d) deposition rate, (e) average transmittance in visible light region, and (f) resistivity were shown. AZO thin films were prepared separately for the case where the mixed powder was used continuously (black line) and the case where the mixed powder was newly replaced for each film deposition (red line). As a result, AZO thin film deposited for 30 min has been obtained the resistivity of $6.7\times10^{-2}$ Ω·cm and the average transmittance of 86.3% in the visible light region. With increasing the deposition times, AZO thin films have been stressed in the film and degraded deposition rate, optical transmittance and resistivity.