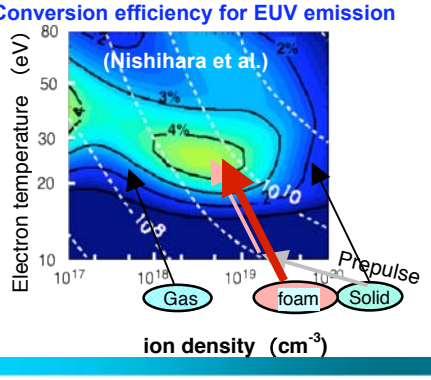
Target Fabrication of low-density and nanostructured laser targets to generate EUV

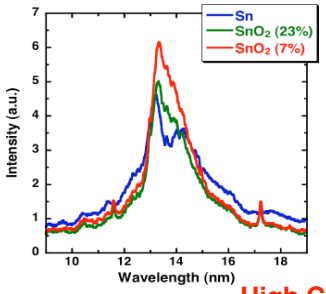
Institute of Laser Engineering, Osaka University, Japan

Introduction: How to control laser plasma - laser and target-

Conversion efficiency for EUV emission



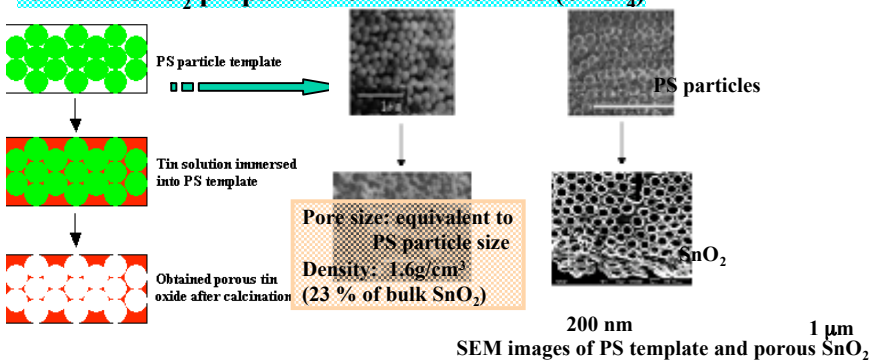
Energy normalized EUV spectra



High CE

Nanotemplate technique

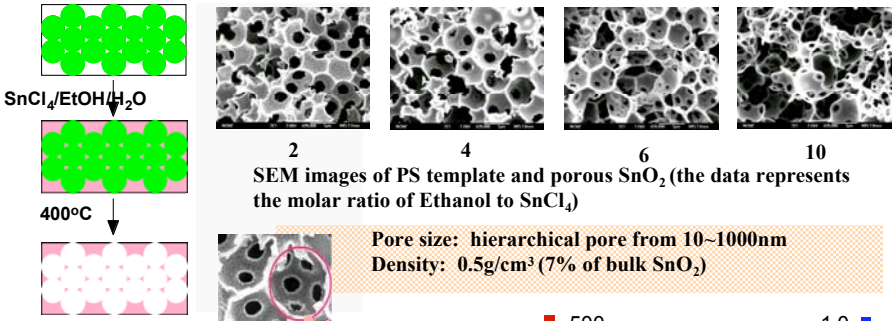
1. 23% SnO_2 prepared from tin chlorides ($SnCl_4$)



SEM images of PS template and porous SnO_2

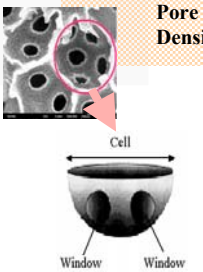
K. Nagai et al., Trans. Mater. Res. Soc. Jpn., 29 (3) 943 (2004)

2. 7% SnO_2 prepared from $SnCl_4$/Ethanol/H_2O solution

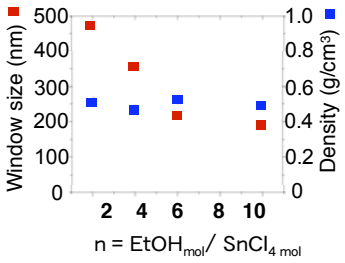


SEM images of PS template and porous SnO_2 (the data represents the molar ratio of Ethanol to $SnCl_4$)

Pore size: hierarchical pore from 10~1000nm
Density: 0.5g/cm³ (7% of bulk SnO_2)



Magnified structure of a cell

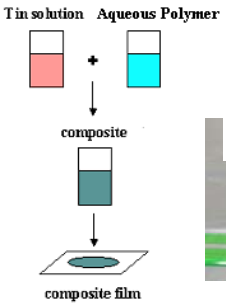


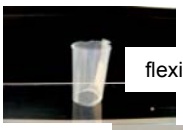
Q.C.Gu et al., Chem. Mater., **17** (5), 1115-1122, (2005).

Keiji Nagai, Q-c. Gu, M. Nagata, T. Norimatsu, S. Fujioka,
H. Nishimura, M. Yamaura,Y. Shimada, M. Murakami,
K. Nishihara, N. Miyanaga, Y. Izawa, and K. Mima

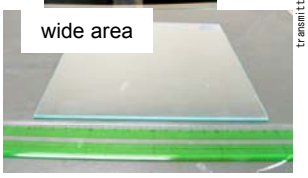
Target with low content tin for high rep. irradiation

Transparent film with 0.1 ~ 100 μm thickness or bulk

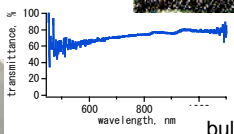




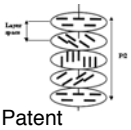
flexible



wide area

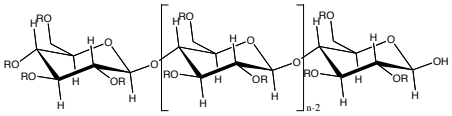


bulk



Osaka U., Kansai TLO co.ltd. Patent

Application for 10 Hz rotation target



rotor

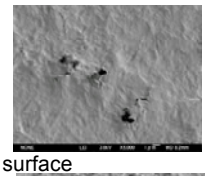
before and after irradiation

diameter 3.3 cm
height 3 cm

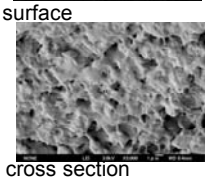
3000 times irradiation
(0.1rps, 5 min)

Oriented SnO2 crystal

Ordered wavy nanocrystal was obtained by heating at 400°C

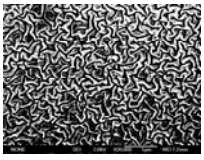


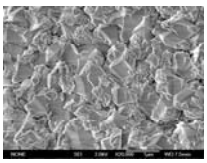
surface



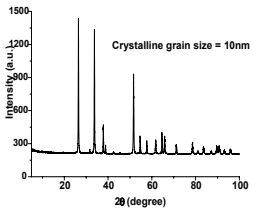
cross section
film x 5000

400°C





SnO_2 x 20000



WAXD pattern of as-prepared SnO_2

Density: 0.5g/cm^3 (28% of bulk SnO_2)

Merits of Cellulose Composite Method

Simple preparation → **Just simply mixing the tin solution and polymer solution**

Excellent filming property → **Make it suitable for multi-shots target fabrication**

Tunable Density → **Density is controlled by the mass ratio of polymer and tin**

A part of this work was performed under the auspices of MEXT (Ministry of Education, Culture, Science and Technology, Japan) under contract subject "Leading Project for EUV lithography source development".