

Supporting Information

Synthesis of highly *c*-axis-oriented ZnO Thin Films using Novel Laser-enhanced Electrospray CVD under Atmospheric Pressure

Satoshi Suehiro^{a*}, Teiichi Kimura^a, Daisaku Yokoe^b and Seiji Takahashi^a

^a*Japan Fine Ceramic Center (JFCC), Materials Research and Development Laboratory,
2-4-1 Mutuno, Atsuta-ku, Nagoya 456-8587, Japan*

^b*Japan Fine Ceramic Center (JFCC), Nanostructures Research Laboratory, 2-4-1
Mutuno, Atsuta-ku, Nagoya 456-8587, Japan*

*Email: s_suehiro@jfcc.or.jp [TEL:+81-52-871-3500](tel:+81-52-871-3500)

Table S1 Experimental conditions

Electrospray	Applied Voltage (kV)	0-20
	Flow rate ($\mu\text{l}/\text{min}$)	70
	Nozzle size (mm)	ϕ 0.4
	Nozzle- substrate distance	60
<hr/>		
CVD	Heating-stage Temperature ($^{\circ}\text{C}$)	0-500
	Pressure (Pa)	1×10^5 (1atm)
	Laser Power (W)	0-300
	Laser spot (mm)	ϕ 30

Preheating stage temperature by laser irradiation

Laser power: 80 W: stage temperature = $\sim 120^{\circ}\text{C}$,

Laser power: 150 W: stage temperature = $\sim 250^{\circ}\text{C}$,

Laser power: 300 W: stage temperature = $\sim 400^{\circ}\text{C}$

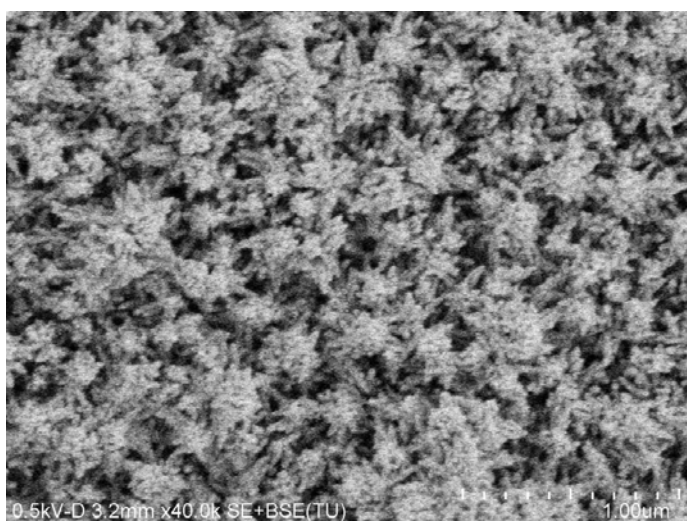


Figure S1 SEM image of surface ZnO thin films by electrospray CVD laser power at 70W

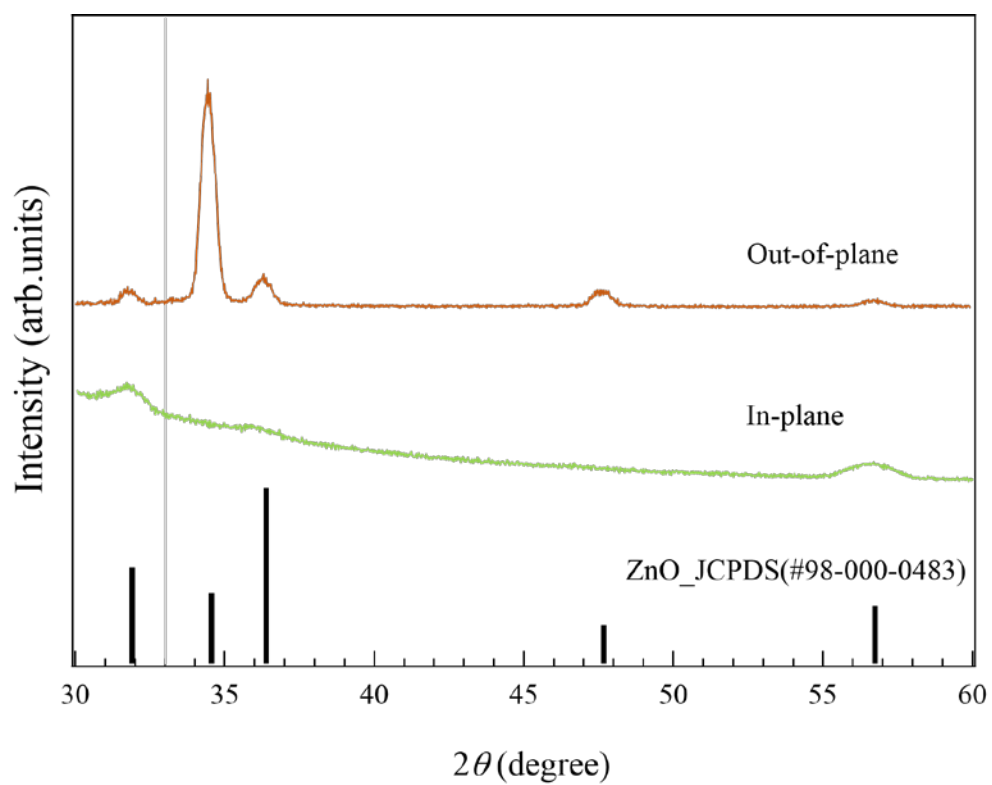


Figure S2 XRD pattern of ZnO thin films by electrospray laser CVD using acetic acid (0.1M)

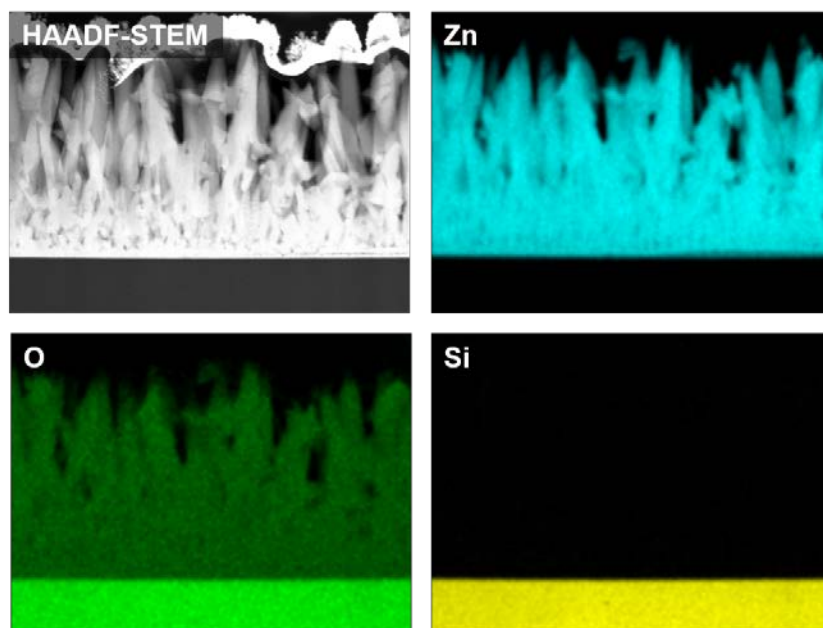


Figure S3 Cross sectional STEM image and EDS mapping of ZnO thin films by electrospray laser CVD using acetic acid(0.1M)

Table S2 Dependence of the morphology of ZnO films using various ZnO precursor solution.

Zn precursor (0.1mol)	solvent	additive	Laser power(W)	Morphology	* temperature (°C)
Zn nitrate ($\text{Zn}(\text{NO}_3)_2$)	ethanol	—	150	nanoparticle	~210
Zn acetylacetonate	methanol	—	150	granular	~370
Zn acetate	methanol	—	80	needle-like	~210
Zn acetate	methanol	glacial acetic acid (0.1M)	80	columnar	~350
Zn acetate	methanol	glacial acetic acid (0.3M)	80	blocked like shape	~630

* measured of surface of the film after LS-CVD using radiation thermometer.

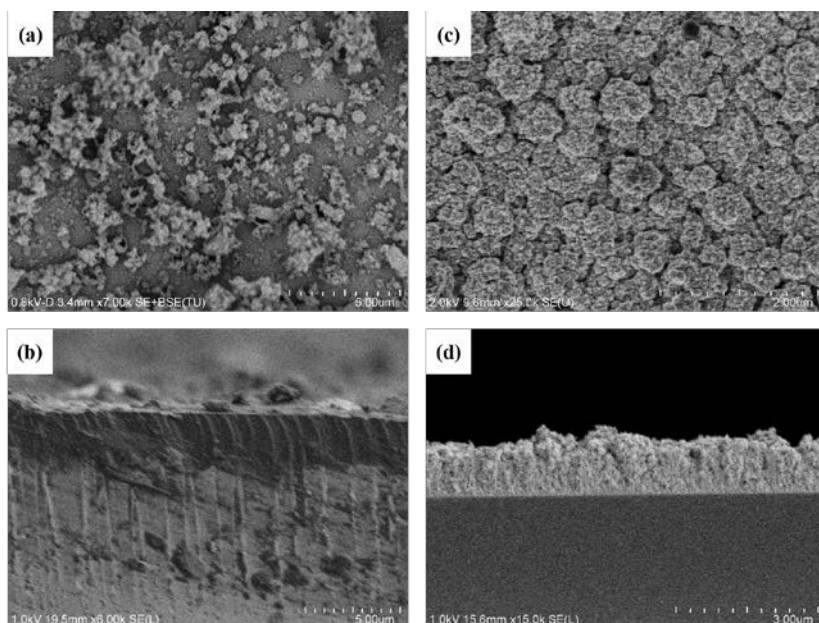


Figure S4 SEM image of surface and cross-sectional image of ZnO film by laser ES-CVD at 150 W using Zn nitrate- ethanol solution(a,b) and Zn acetylacetonate-methanol solution(c,d) laser power.

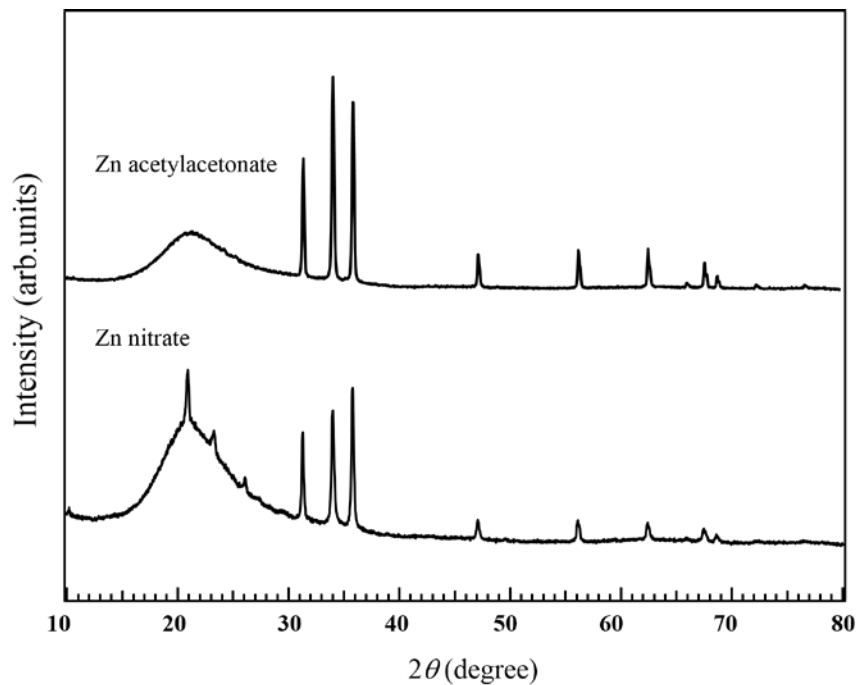


Figure S5 XRD pattern of ZnO thin films deposited by laser ES-CVD using Zn nitrate- ethanol solution and Zn acetylacetonate-methanol solution

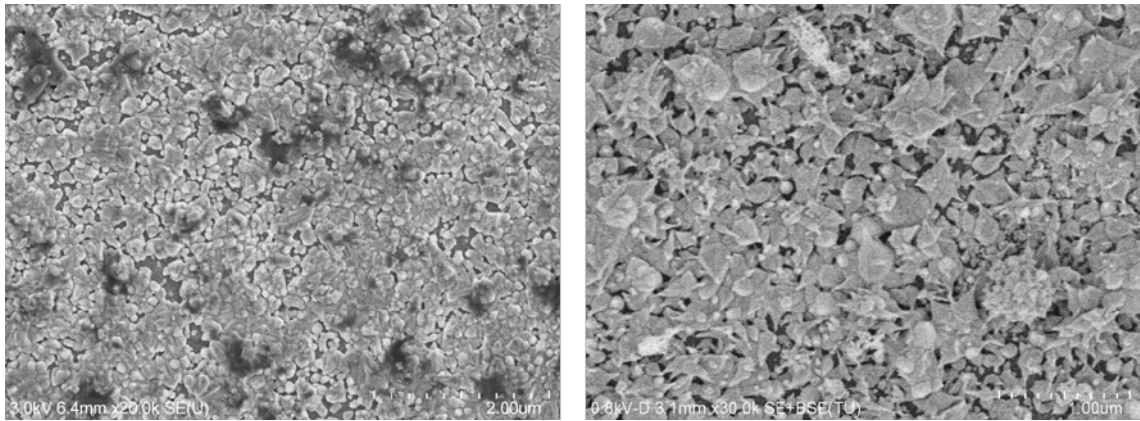


Figure S6 SEM image of surface of ZnO films deposited by laser ES-CVD at 300W