



## OBTAINING HIGHLY CONDUCTIVE ZnO:Ga:Cl CERAMICS AND THIN FILMS AT LOW TEMPERATURES

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**APPLICABILITY:** Optoelectronics.

**SCOP:** The elaboration of cost-effective technology for low temperature deposition of highly conductive ZnO thin films.

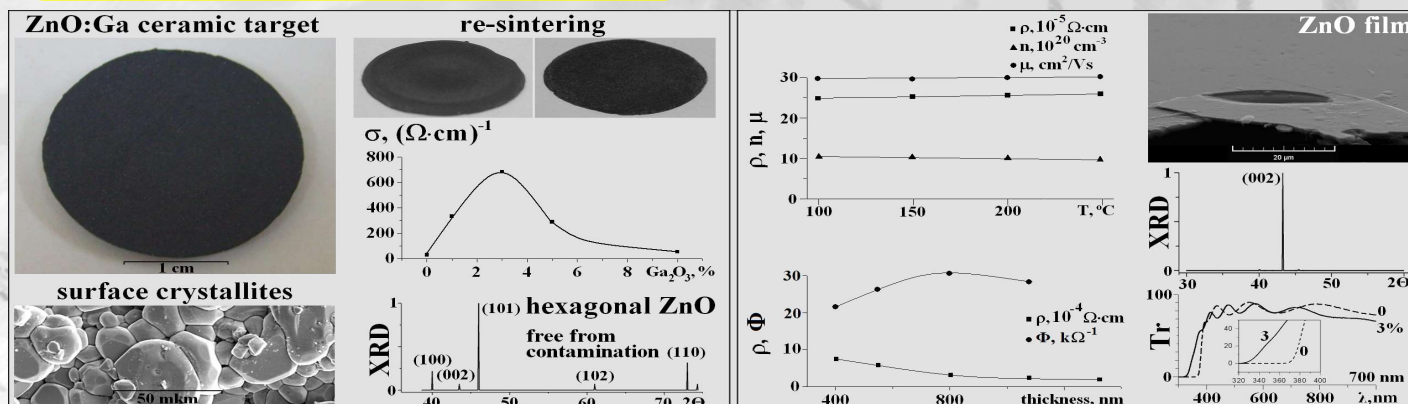
### SOLUTION (ceramic targets)

ZnO+Ga<sub>2</sub>O<sub>3</sub> mixed powder is sintered using HCl transport agent: HCl increases the solubility rate of Ga<sub>2</sub>O<sub>3</sub> by 7 orders of magnitude, Ga<sub>2</sub>O<sub>3</sub> solubility limit is as high as 3 mol % (2-3 times higher compared to other methods)

### SOLUTION

(magnetron deposition of films)

High concentration of Ga (6 at. %) results in a high doping level of films, Cl impurity favors the incorporation of Ga even at low growth temperatures (100 °C), increasing the transparency, concentration and mobility of charge carriers



### ADVANTAGES (ceramic targets)

- ❖ Low sintering temperature of 1050 °C
- ❖ 99% of the initial diameter
- ❖ 80% of single crystal hardness
- ❖ 95% of ZnO density
- ❖ High conductivity of 700 (Ω·cm)<sup>-1</sup>
- ❖ Free from powder pressing
- ❖ Possibility of multiple resintering
- ❖ High solubility limit of 3 mol %

### ADVANTAGES

(100 °C deposition films):

- ❖ Doping efficiency by Ga at 100 °C deposition is as high as at 250 °C;
- ❖ Low resistivity of 2.5·10<sup>-4</sup> Ω·cm;
- ❖ High mobility of 30 cm<sup>2</sup>/Vs;
- ❖ High transparency of 80 %;
- ❖ High figure of merit of 31 kΩ<sup>-1</sup> (800 nm); one of the highest value achieved for transparent electrodes

**STAGE:** Pilot.

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