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Transparent thin film of zinc oxide for solar cells applications fabricated by pulsed laser deposition

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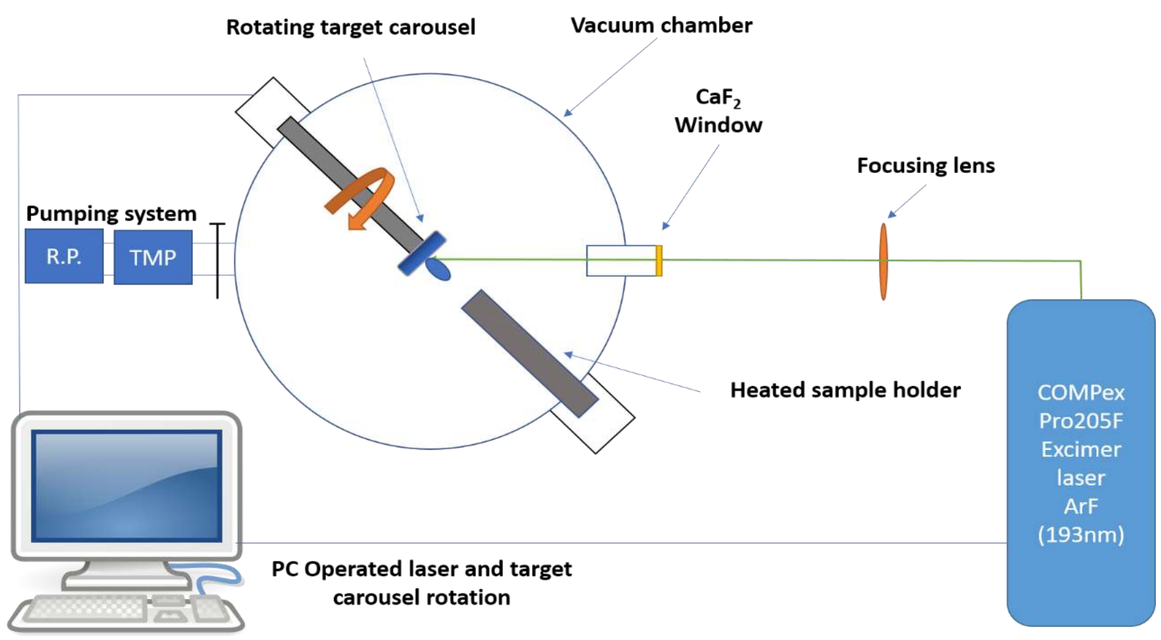
Motivation

❖facile zinc oxide (ZnO) synthesis of zinc oxide based nanomaterials with specific properties is a great challenge due to its excellent industrial applications in the field of semiconductor and solar cells.

❖zinc oxide (ZnO) thin films and nanostructures attracted a great interest in last decades owing to their unique properties such as large exciton binding energy (60 meV), direct wide-bang gap of about 3.4 eV at room temperature, high optical transparency in the visible region, low electrical resistivity as well as high electrochemical stability, high electron mobility, non-toxicity and abundance in nature

Experimental Device



Pulsed laser deposition

❖ Pulsed laser deposition (PLD) has been studied and employed as relatively simple and reliable technique for depositing a wide range of materials for novel applications

❖ Stoichiometric process

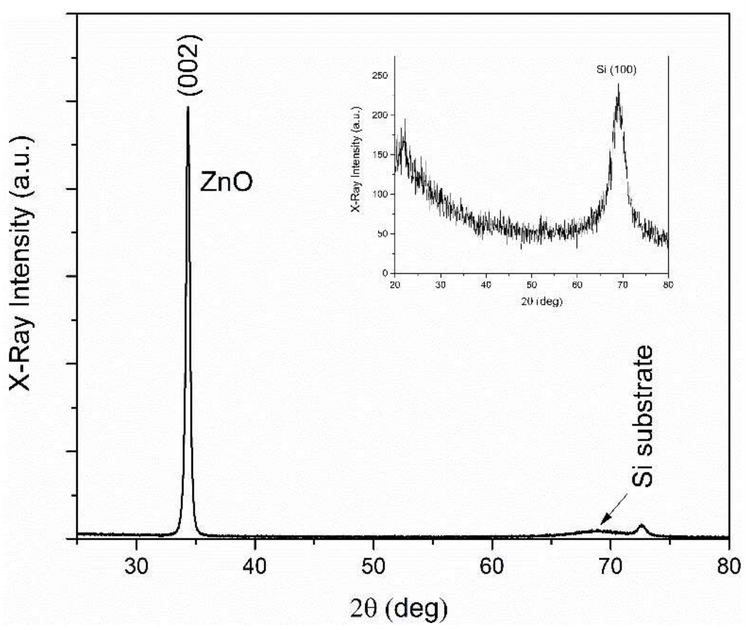
❖ Excimer laser represent one of the most popular gas-based lasers, generating intense short pulses in the ultraviolet spectrum

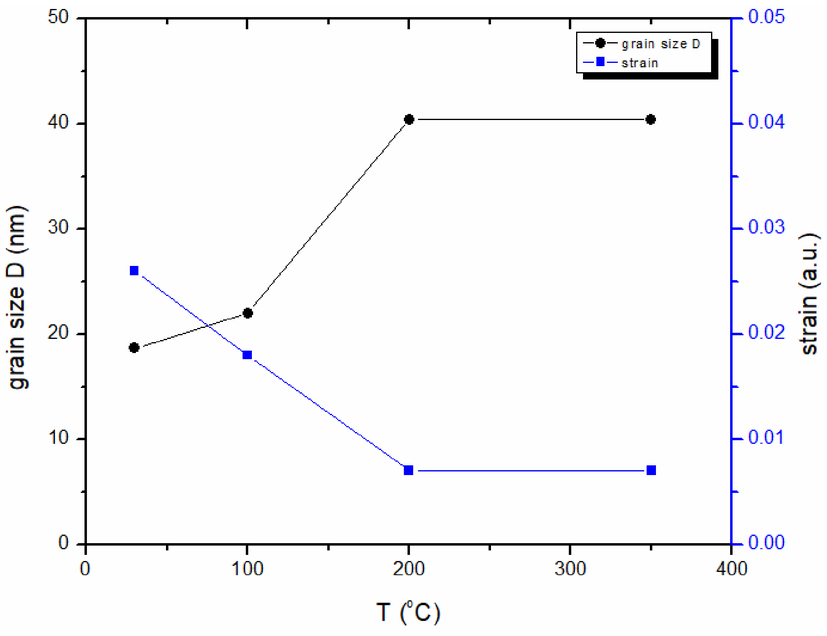
❖ Excimer lasers have the ability to produce a wide range of processing power with variable repetition rates

❖ Clean method with no chemical contaminants

Results

Structural properties – XRD measurements



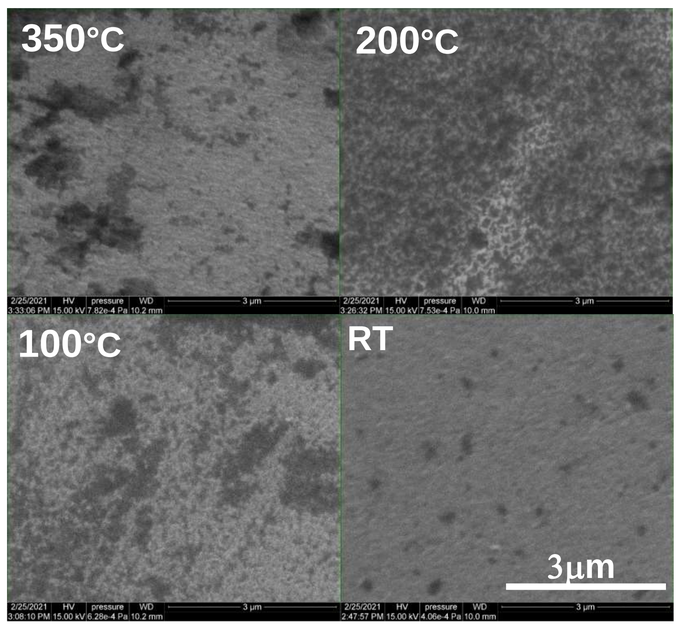


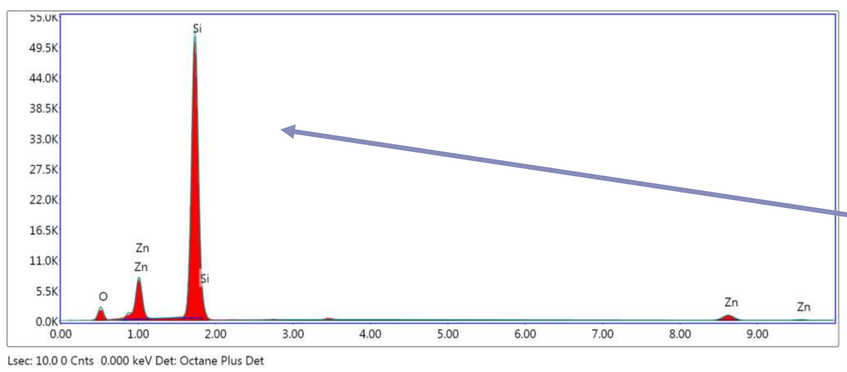
❖ Highly oriented ZnO thin films – (002) plane – are deposited by PLD

❖ Calculated crystalline distance *d* are temperature depend – crystalline distance increases with respect to substrate temperature

❖ Increasing substrate temperature to about 350°C the thin films become almost stress free.

Surface morphology and chemical composition – SEM and EDS measurements

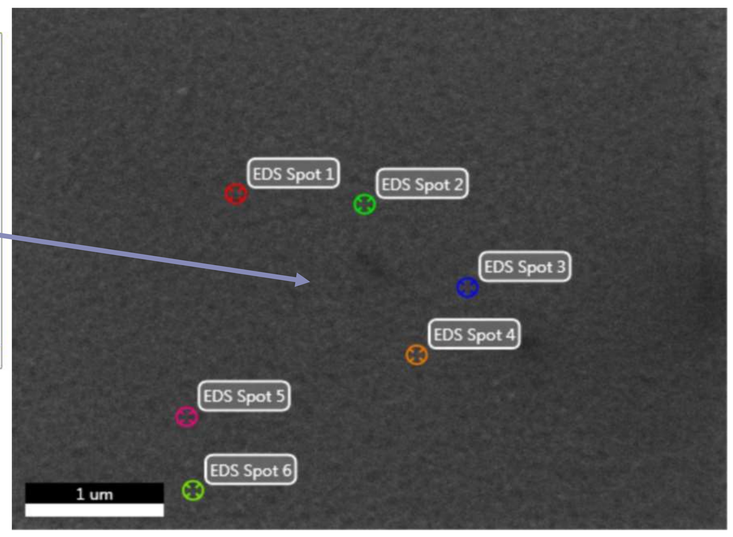




❖ Surface morphology of the ZnO thin films is in good agreement with the calculated values from XRD measurements.

❖ EDS measurements indicated highly pure and uniform films

❖ the ratio of Zn to Si (the substrate) was about 13.2±0.2%



Conclusions

✓ Highly oriented ZnO thin films can be obtained by PLD

✓ Substrate temperature is crucial for crystalline size and surface morphology of ZnO

Future prospects

✓ . Creating a heterojunction of n-ZnO/p-Si has the potential of integrating it in a wide range of application such as gas sensors, solar cells, photodiodes and many others.

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