# Dynamic deposition rate increase of $TiO_2$ thin films using serial reactive magnetron co-sputtering for industrial applications

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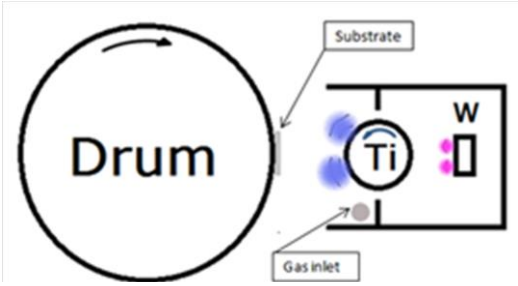
Reactive Sputter Deposition

## Introduction

$TiO_2$ thin films are widely used in the optical device applications. The low sputtering yield of Ti in the oxide mode is the significant disadvantage for industrial applications of the reactive magnetron sputtering. Higher sputtering yield can be achieved by serial magnetron co-sputtering through doping of the surface of sputtering target by heavy elements in the order to reduce the depth of the collision cascades. For example, deposition rate of $Al_2O_3$ can be increased by 80 % through W doping [1].

## Experimental details

- Ti rotary cathode sputtered in puled DC mode at P=9.5 kW, 100kHz
- Doping W cathode sputtered in DC mode at:
  - P = 1 kW
  - P = 2 kW
  - P = 3 kW
- Drum speed: 0.2 m/min.



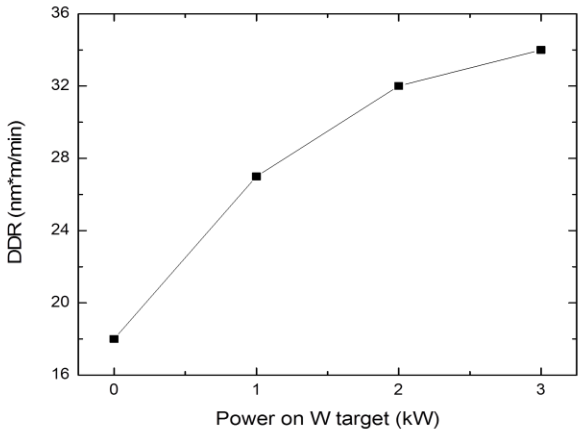

## Conclusions

Dynamic deposition rate (DDR) was studied as a function of power on additional W target. Comparing numbers that were achieved without co-sputtering to number which were gained with additional W magnetron it is easy to notice significant sputtering yield amplification. Even using relatively small amount of power on W cathode we achieved DDR increase by 30% at a 5.5% of tungsten doping in the coating. It is possible that this method can help in achieving higher product outcome in the industrial coaters.

## Results

| Sputtering Mode | Power (kW) | Layer Thickness (nm) | Dinamic Deposition Rate (nm*m/min) |
|---|---|---|---|
| $TiO_2$ | 9.5 | 486 | 18 |
| $TiO_2$ + W | 9.5(Ti) + 1(W) | 823 | 27 |
| | 9.5(Ti) + 2(W) | 964 | 32 |
| | 9.5(Ti) + 3(W) | 1026 | 34 |

| Sample | | | | |
|---|---|---|---|---|
| | Ti At% | W At% | Ti Wt% | W Wt% |
| $TiO_2$ + W (1kW) | 94.469 | 5.531 | 81.652 | 18.348 |
| $TiO_2$ + W (2kW) | 90.784 | 9.216 | 71.96 | 28.04 |
| $TiO_2$ + W (3kW) | 89.155 | 10.845 | 68.172 | 31.828 |




## References

[1] T. Kubart, R.M. Schmidt, M. Austgen, *Surface & Coatings Technology* **206** (2012) 5055-505

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