

# Reactive Sputtering of Optical Coatings: Effect of Power Delivery Configurations

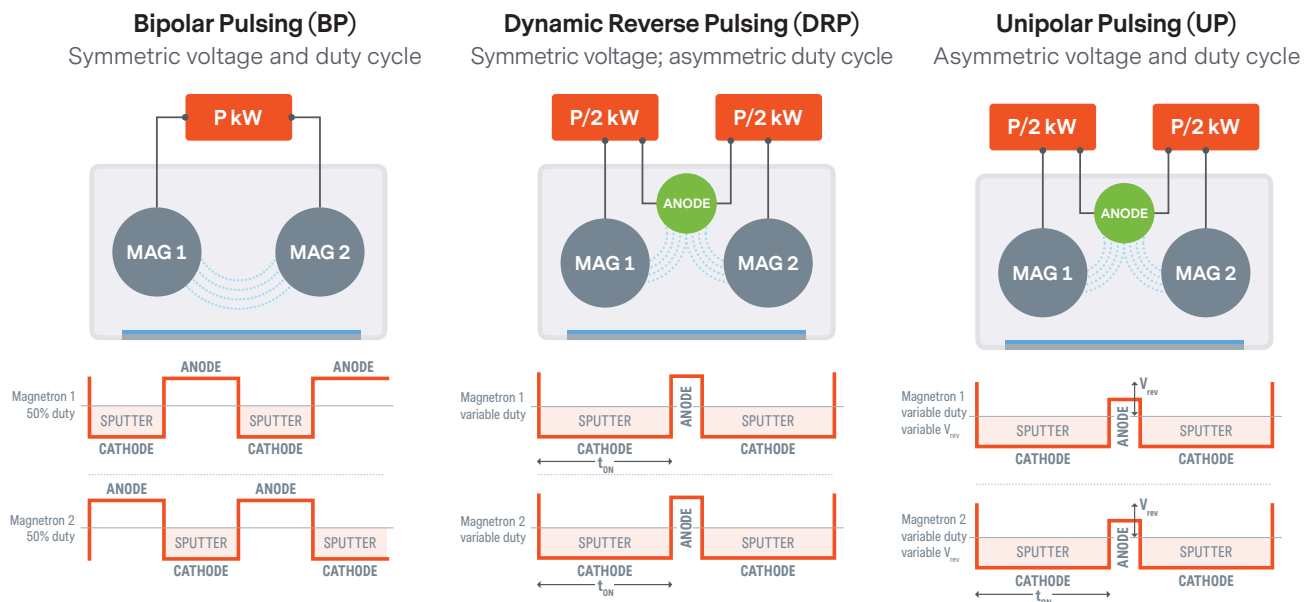
## Introduction

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In order to deposit dielectric films by reactive sputter deposition, a variety of plasma power supply options and configurations are available for delivering power to the magnetrons. Based on the target and/or source material used to create the properties required for the optical thin film, particular configurations can outperform other available options. This work compares three commonly utilized power configurations for the deposition of  $\text{SiO}_2$  and  $\text{TiO}_2$ .

The research presented here is intended to help you choose the right power supply and pulse mode for reactive sputter deposition.

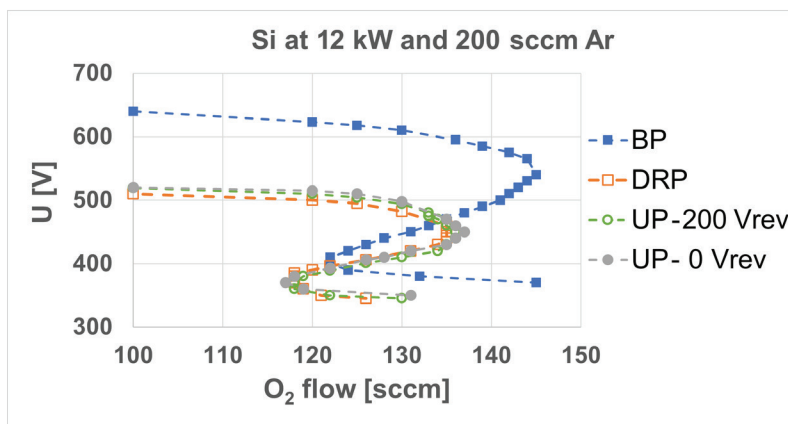
## Power Configurations



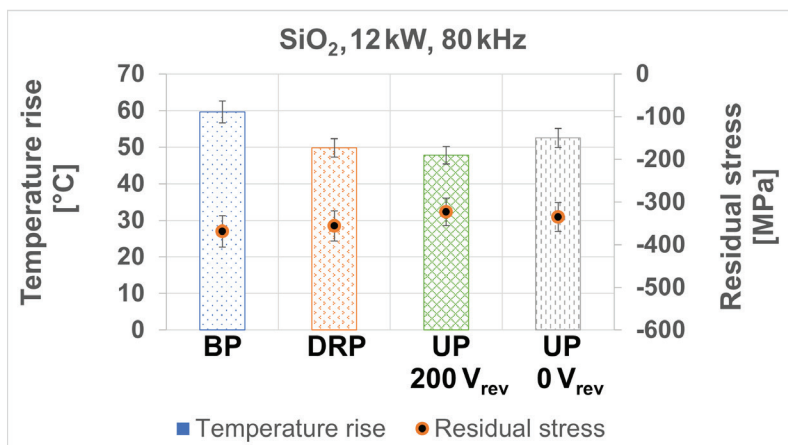
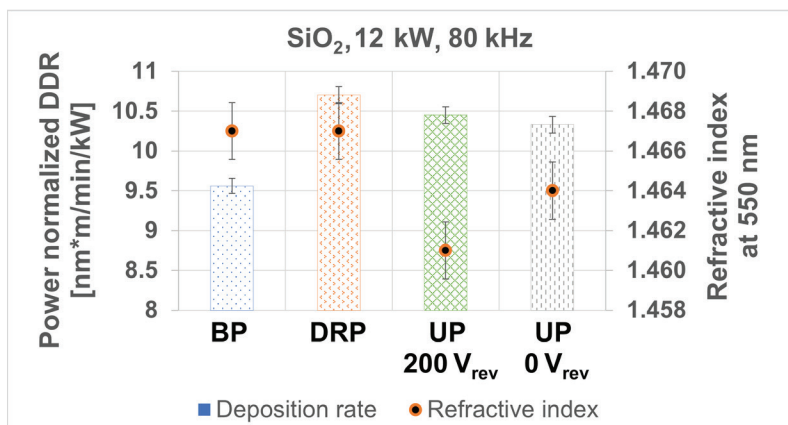
## Salient Features: BP vs. DRP/UP

- Variable reverse voltage (UP) and reversal time (DRP/UP) allow large parameter flexibility as per process or material requirement. Higher duty cycles, compared to BP, are achievable.
- Current at the endblocks can be doubled in DRP/UP modes compared to BP mode — higher power applicable.
- Plasma behavior is different when pulsing the magnetron against an anode (DRP/UP) vs. when two magnetrons pulse against one other (BP).

# SiO<sub>2</sub> from Si Target



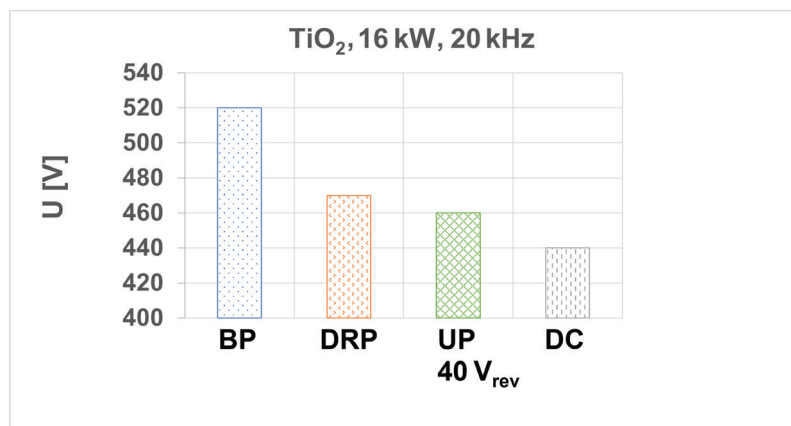
- Hysteresis sweep in U-controlled mode shows similarity between DRP and UP modes.
- For depositions at similar working points, discharge voltage will be higher with BP mode as compared to DRP/UP modes.



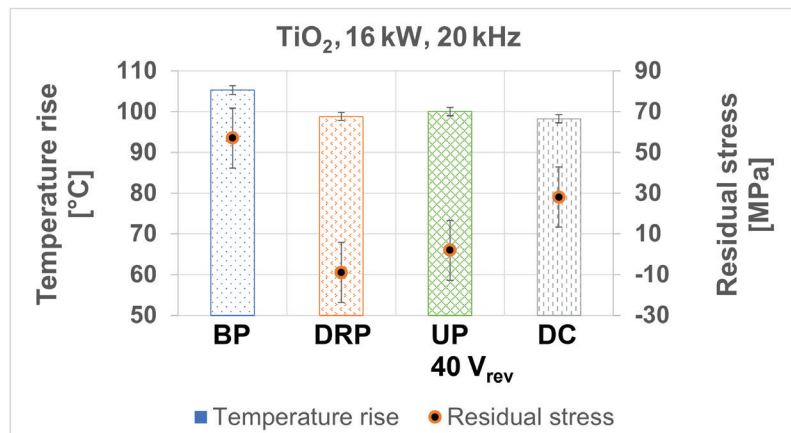
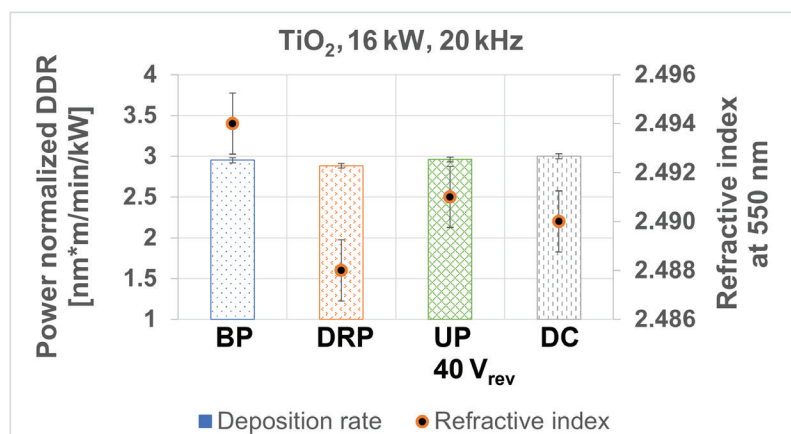
There was a ~10% increase in deposition rate with DRP/UP modes.

There was a ~12% decrease in heat load with DRP/UP modes.

## TiO<sub>2</sub> from TiO<sub>x</sub> Target



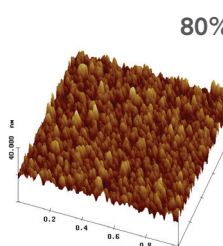
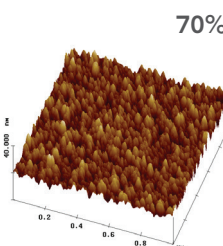
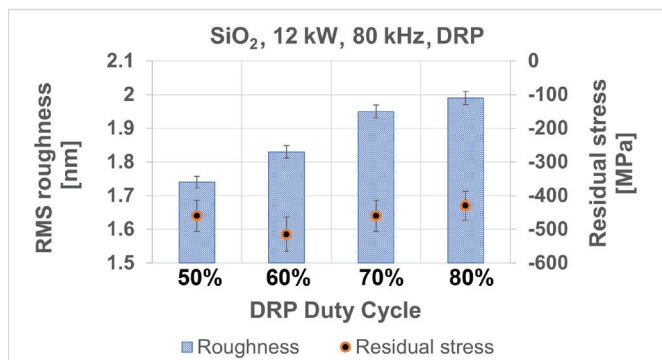
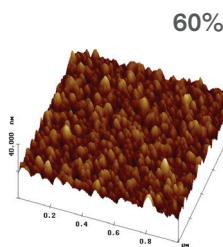
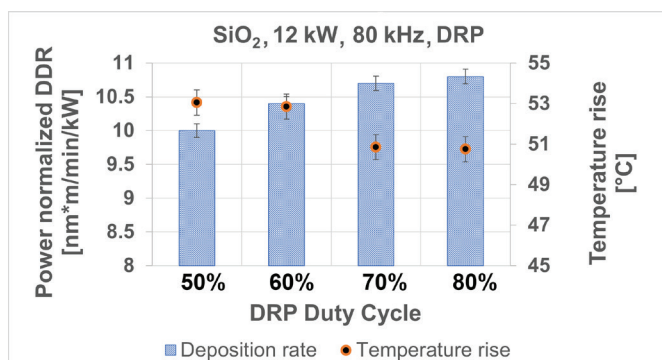
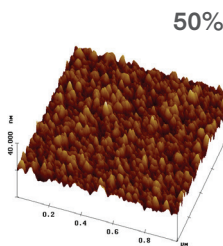
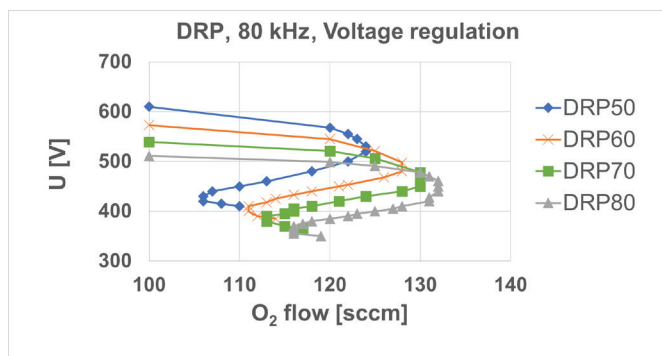
- A TiO<sub>x</sub> ceramic conductive target was used, allowing DC depositions. 4% O<sub>2</sub>/Ar gas flow rate was used.
- Discharge voltage again was higher for BP mode as compared to DRP/UP modes, with lowest for DC mode.



The deposition rate is similar with all modes.

The heat load is slightly higher with BP mode.

## More on DRP: Effect of Duty Cycle



## SUMMARY

Choosing the right power supply and the right pulse mode is a key requirement of sputtering processes, especially for reactive sputter deposition. This choice depends on the system requirements, long-term process stability, arc mitigation, and strongly on the material system and coating requirements. Testing demonstrated the effect of different configurations and modes to support decision-making based on your specific requirements.



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