

## Magnetron sputtering vs RF sputtering: What's the difference?

When thin films need to be added to a surface, sputtering techniques are there to help. They can produce a coating with a specific placement that's only several atoms thick. We see the benefits of these properties in everyday items. The coatings from sputtering techniques provide them with extensive functionality, strength, and durability. With many different sputtering techniques available, it's important to understand the variations between them. Below we're going to consider two of these sputtering techniques and what makes them distinct: Magnetron sputtering and RF sputtering.

### Understanding Sputtering Techniques

#### Magnetron Sputtering

Magnetron sputtering utilizes a magnetic field to enhance the speed of its sputtering process. That way it can quickly produce an extremely uniform coating. As seen within a standard sputtering procedure, plasma is generated in a vacuum chamber, its positively charged ions bombarding a target material before knocking away molecules or atoms on its surface. However in magnetron sputtering, the target is surrounded with a magnetic field to keep the electrons confined near its surface. The inclusion of the magnetic field causes the electrons to start spiraling but stay put, keeping the plasma sustained and, thus, improving the efficiency of the ionization process. Moreover, the magnetic field can amplify the rate of ion bombardment that occurs with the target. This provides a boost to the sputtering rate and ensures deposition is quicker and has better uniformity. Finally, the atoms are then able to move within the chamber and attach to the surface of the substrate to produce a layer.

#### RF Sputtering

Known for delivering complicated but precise coatings for materials which direct current (DC) sputtering cannot manage, RF sputtering tends to be used for applications that involve optics, nanotechnology, and electronics. The RF sputtering process does share some resemblance to DC sputtering in its setup. But it does not use a constant direct current for producing plasma. Instead, it applies an alternating current at radio frequencies, usually at 13.56 MHz. This current has its direction alternated by the RF power source numerous times every second. By quickly switching the polarity, ions and electrons will move back and forth, traveling between the plasma and target, stopping charge build-up from occurring with non-conductive materials. Once the plasma is produced, it emits ions that hit the target material, causing its own atoms to be knocked off. The atoms move onto the substrate and establish a layer that's both even and thin.

### What Makes Magnetron Sputtering and RF Sputtering Different?

#### 1. Power

Magnetron and RF sputtering are both powered differently. Magnetron sputtering utilizes DC power, usually in tandem with a magnetic field, while RF sputtering applies radio frequency power. This helps it to change its current and avoid charge build-up.

## 2. Setup

Unfortunately, magnetron sputtering does have a more complicated setup than RF sputtering. It requires magnets or magnetic coils placed about the target to keep the electrons contained at its surface. Meanwhile, RF sputtering has a more straightforward setup than magnetron sputtering. It requires a RF power supply and a network that matches to manage the alternating current.

## 3. Materials

Although RF sputtering can be utilized with conductive materials, its ability to work with non-conductive materials is one of its strengths. RF sputtering offers a way of overcoming charge build-up, something which cannot be done with DC power. This means RF sputtering is an excellent choice for producing the thin films required by optics and electronics.

On the other hand, magnetron sputtering is better with conductive materials, like metals including titanium, copper, and aluminum. It can produce metal and conductive compound coatings that are uniform and high-rate. Magnetron sputtering can also be used with non-conductive metals, but only if it incorporates RF power.

## 4. Film Quality

Magnetron sputtering can produce uniform films of good quality for areas of larger sizes. Their magnetic field enhances the ion density close to the target. Therefore, the coating will have better uniformity and be produced efficiently and quickly. However, RF sputtering delivers a higher level of quality than magnetron sputtering. It offers precise, smooth, and thin coatings thanks to its alternating current stopping charge build-up from taking place.

## 5. Deposition Speed

With its magnetic field, magnetron sputtering can deliver an increased deposition rate, enhancing sputtering efficiency and plasma density. Thus, it's useful for those requiring a quick technique for high-volume production. Although RF sputtering is imbued with a slower deposition rate, remember it can still deliver a precise coating.

## Which Sputtering Technique Will You Choose?

Magnetron sputtering and RF sputtering each have their own strengths when it comes to producing a coating. Although magnetron sputtering may have a setup that's more complex, it offers good film quality and has a fast deposition speed. At the same time, RF sputtering delivers outstanding film quality and can generate coatings for an array of both conductive and non-conductive materials.

Your decision as to whether you will use magnetron or RF sputtering will fall upon which would suit your application best. So think carefully about which would fit your work and produce a coating you will be content with. Nikalyte are experts in both magnetron sputtering and RF sputtering and offer a range of solutions for producing uniform thin films. Our stellar magnetron sputter sources are UHV compatible and fully bakeable and can be provided as

standalone instruments or as part of a full PVD vacuum system. [Click here to learn more about our PVD systems.](#)