**Reactive High Power Impulse Magnetron sputtering of oxide thin films**

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Thin films of metal oxides are widely used in many applications. In general, there is a great interest in deposition techniques that enable phase control of oxide thin films. However, synthesis of crystalline films may be challenging when the growth temperature is limited, for instance on temperature sensitive polymer substrates. TiO2 is one example of a material where specific crystallinity is frequently required.

Physical vapour deposition methods such as magnetron sputtering can reduce the growth temperature by employing energetic species. The growth of crystalline TiO2 thin films by physical vapor deposition techniques typically requires a deposition temperature well above 200°C. Therefore, this contribution deals with reactive magnetron sputter deposition of TiO2 thin films with ion assistance using reactive high power impulse magnetron sputtering (HiPIMS). Specifically, energy input during the film growth is analyzed and different contributions are discussed.

It is shown that the geometry of the deposition system is an important factor. With a long target-substrate distance, the total energy flux is too low and the deposited films remain X-ray amorphous irrespective of the ion energy unless substrate heating is applied. Despite that, films prepared by an optimized HiPIMS process exhibit up to 3 times higher photocatalytic activity evaluated by photodegradation of stearic acid, as compared to reference pulsed DC films prepared using the same setup. Furthermore, by tuning the oxygen partial pressure and deposition rate, the internal disorder in the deposited thin films can be increased, making them suitable for crystallization during post-deposition annealing.

When the target-to-substrate distance is reduced, the total energy flux is increased. As a result, the film crystallinity is greatly improved. Growth of anatase as well as rutile can be achieved by changing the total deposition pressure. Even here, the HiPIMS process facilitates crystallization of the films as compared to pulsed DC. The deposition, however, results in a pronounced unintentional heating of the substrate and the ion energy is only a smaller part of the total energy input.

In summary, the HiPIMS deposited films clearly outperforms the ones prepared by pulsed DC. Although the exact growth conditions depend on the deposition geometry and specifics of the deposition setup, some general trends can support the process development.