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SIMULATIONS OF A FILM/SUBSTRATE TEMPERATURE ELEVATION DURING A MAGNETRON DEPOSITION

N. Britun*, K.S. Shin, and J-G Han
1Center for Advanced Plasma Surface Technology, SungKyunKwan University,
300 Chun-Chun-Dong, Jangan-gu, Suwon 440-746, Korea
*e-mail : britun@skku.edu, hanjg@skku.edu

Abstract

Magnetron sputtering [1] recently becomes one of the leading techniques in coating industry due to the potential of versatile and precise control of film microstructure along with related properties such as film density, adhesion, surface roughness, and crystallinity [2] as well as due to the cost effectiveness for industrial applications overcoming current barriers which exist in other film deposition processes.

In particular, a low temperature film deposition in magnetron sputtering is a new technical area which is directly related to a low temperature polymer processing in such applications like production of flexible displays, e.g. Organic Light-Emitting Diodes (OLED) [3].

The control of the energy flux incoming to growing film surface during magnetron sputtering is especially important for film structure design since the energy of sputtered particles is rather high [1], especially at low working pressures when a ballistic mode of sputtering takes place and an additional bombardment of the film surface by neutral particles might be considerable.

In this work a simulation of a substrate (and film) temperature elevation during film deposition in a magnetron sputtering was performed for different sputtering conditions assuming a film with homogeneous thermal characteristics. The effects of substrate and film material, substrate thickness, film and substrate emissivity are studied. The connection between the discharge conditions and the film structure is considered using Ti films deposited in a dc mode and compared to the Film Structure Zone Model (SZM) [4].

Results show that at low working pressure an additional bombardment of a film surface takes place, which can be determined indirectly from simulation. Both substrate and film temperature can be efficiently controlled by varying the sputtering conditions as well as the parameters of film and/or substrate.

References

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