

SHORT COMMUNICATION

Electrical Properties of Titanium Nitride Thin Films Deposited by Reactive Sputtering

K. KAWABATA

Department of Electronic Engineering, Hiroshima Institute of Technology, Hiroshima, Japan

and

T. MUTO

Department of Electronic Engineering, Tokyo Denki University

Recently, tantalum nitride has become widely used as a resistive material for hybrid integrated circuits; however titanium also has suitable properties which are similar to tantalum, and moreover its cost is lower.

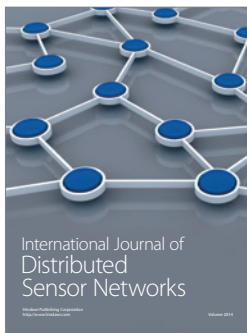
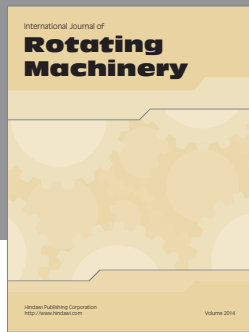
In the paper, the electrical properties of titanium nitride films were studied with regard to the characteristics of resistive material. The films have been r.f. sputtered on glazed ceramic substrates in an argon–nitrogen plasma. The total pressure of mixed gases of Ar and N₂ was about 1×10^{-3} Torr. The value of the partial pressure of N₂ (P_N) was fixed in the range from 2×10^{-4} to 2×10^{-5} Torr, with the remaining pressure being due to argon. During the sputtering process the substrate temperature was kept at constant as 300°C.

By the above method we obtained the following characteristics for films; Resistivity: 270 ~ 300 $\mu\Omega$ cm., TCR: -100 ~ + 100 ppm/°C.

For the investigation of film structures, we performed X-ray analyses and found that film structure depended on the partial nitrogen pressure, p_N . When p_N was low, we observed small quantities of α -Ti mixed in the TiN, but for higher N₂ partial pressure, the films were mainly TiN. The size of the crystal grains also depended on p_N . (e.g., sizes of 256 Å and 150 Å for a nitrogen pressure of 1×10^{-5} Torr and 3×10^{-5} Torr, respectively.)

An investigation has also been made on the stability of the characteristics. We have stored samples in a N₂ environment (1×10^{-4} Torr) at 300°C for one hour, the TCR of the samples stabilized in the range -50 ~ +50 ppm/°C.

In summary, we consider that titanium nitride films have similar properties to TaN.




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