Hardness studies of RF sputtered deposited BCN thin films

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In today's technological advancement of ULSI integration, the inter-dielectric layer (IDL) with small RC delays needs low-k materials which are sturdy enough to withstand mechanical stress posed by multilayer devices. Also it has to prevent any metallic diffusion into the dielectric layer. Some porous materials like silicon dioxide doped with fluorine reduces k value around 3. Using organic polymers that are porous in nature can achieve dielectric values as low as 2. Even though one can achieve low-k with these materials, these materials cannot withstand considerable mechanical stress. Recently it has been found that Boron Nitride (BN) films can achieve low-k values around and hardness comparable to diamond [1][2]. BN is hygroscopic in nature. In this respect carbon can be added to the BN structure to produce Boron Carbon Nitride (BCN) films as the possible substitute for BN. The minimum dielectric constant achieved by plasma assisted chemical vapor deposition for a BCN thin film was reported to be 1.9. [2] The BCN films are also instrumental in suppressing the Cu migration [3]. The Young's modulus of BCN films are reported well above 20 GPa making it one of the suitable options for low-k materials [4].

In the present work, BCN films were deposited by RF sputtering of boron carbide (BC) target in nitrogen ambient with argon. The films were deposited under various N_2/Ar gas flow ratios. FTIR measurements were performed to find the chemical bonds of the deposited films. Investigations were performed to evaluate the Hardness (H) and Young's modulus (E) of the deposited films under various conditions.

REFERENCES

[1] Jun Liu, Kian Ping Loh, Ming Lin, Yong Lim Foo, Wei De Wang, and Dong Zhi Ch, Journal of Applied Physics, **96** (2004) 6679.

[2] Riedel R., Advanced Materials, 4 (1992) 759.

[3] M. K Mazumder, R. Moriyama, D. Watanabe, C. Kimura, H. Aoki, and T. Sugino: Jpn. J. Appl. Phys. 46 (2007) 2006.

[4]C. Morant, D. Caceres, J. M. Sanz, and E. Elizalde: Diamond Relat. Mater. 16 (2007) 1441.