Boron Nitride Materials for Next-Generation Interconnect Technologies

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Abstract

With the current explosion in data, high-performance computing and the advent of new technologies such as super-large artificial intelligence (AI), the demand for high-performance processors for computation and high-capacity memory for data storage is rapidly increasing. Also, with continued device scaling, the interconnect for fast and energy-efficient signal processing between processors and memory have increasingly become the technological bottleneck significantly impacting the performance and reliability of electronic devices. The performance of the interconnect is basically dictated by the resistance and capacitance (RC) signal delay, which in turn, is related to the metal wire resistance, dielectric layer capacitance, and interconnect dimensions. Over the years, key interconnect components such as metal wires, diffusion barrier/liners have evolved with material and structural innovations to match the performance requirements of next-generation devices. However, the low-k interlayer dielectric materials have had difficulties with materials innovation since the early 2000's, struggling with limits to permittivity scaling and required material requirements until the recent discovery of amorphous Boron Nitride (a-BN) which demonstrated mechanically and electrically robust films with ultralow κ values <2.0.

In this talk, the evolution of the development of low-k materials and the recent progress of a-BN ultralow-k (ULK) dielectric materials are presented. The materials design of ultralow-k materials and the outlook on the prospects of ULK dielectric applications in next-generation semiconductor devices are discussed.

References

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