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HDP-CVD for the silane-based deposition of dielectrics

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Résumé :

Silicon-based dielectrics constitute the bulk of dielectric films used currently in microelectronics, optics, photovoltaics and functional and protective coatings applications as they offer exceptional electrical, optical, chemical and barrier properties and can be deposited by large number of techniques giving the engineer a free hand to tailor the technology for specific application. Until mid-seventies most of processing steps in solid-state technology were using atmospheric pressure and high temperature: diffusion, oxidation, epitaxy, chemical vapor deposition (CVD). However, with an advent of multilayer Al metallization, need for a low-temperature deposition of intermetal and interlayer dielectric and encapsulation layers has given green light to the introduction of plasma enhanced CVD into the process flow. Currently, number of PECVD steps in advanced ULSI fabrication sequence may total several tens. As solid-state technology continues to develop, new problems, that arise, sometimes cannot be solved within existing toolbox and require new approaches. Plasma technology is not an exception. At the end of eighties continuing miniaturization of microelectronic components was impeded by drawbacks of classical realization of CCP deposition and number of new different plasma sources was called to the rescue, opening the field of high-density plasma CVD (HDP-CVD). There was flurry of research activity and it was very interesting area for me to work in. New sources did not displace CCP, which is continued to be used on certain steps at the highest levels of semiconductor technology, but they removed the roadblocks to advance the design of ultra large-scale integration (ULSI) circuits and keep Moore's law on track. During last 30 years HDP-CVD technology was born, hyped, sized properly and became standard tool for number of applications. I will discuss its development, past and new implementations and problems, new developments, both within and outside of microelectronics and discuss its interaction with complementary deposition techniques and possible new applications.