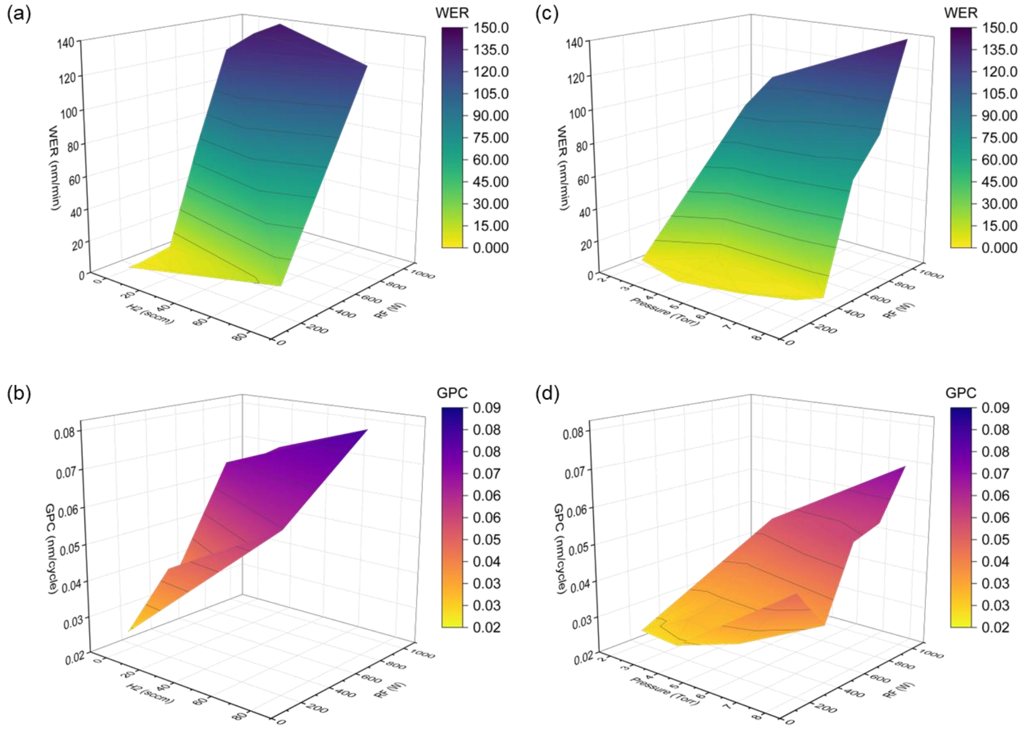

Figure 1. Impact of plasma parameters and pressure on the growth kinetics and etch resistance of PEALD- SiN_x on Si wafer. (a, b) Wet Etch Rate (WER) and Growth Per Cycle (GPC) as functions of H_2 flow rate and RF power. (c,d) WER and GPC dependency on process pressure and RF power. Our findings demonstrate that across a broad pressure window, a regime of reduced RF power and H_2 flow is essential for the synthesis of high-density SiN_x films with minimized plasma-induced damage.

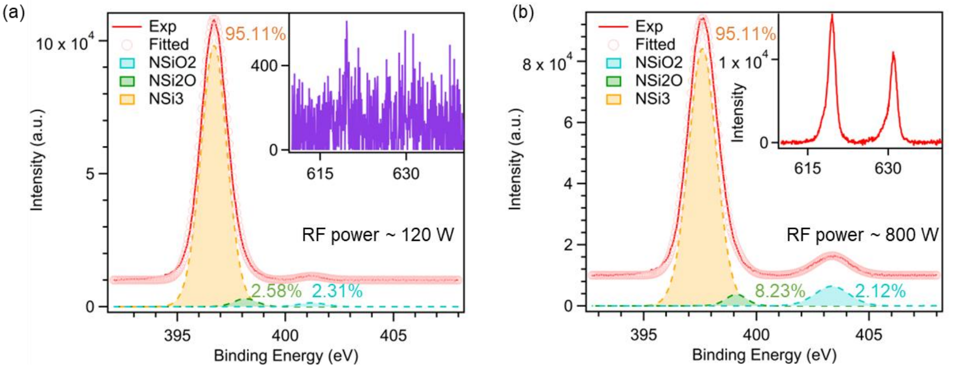

Figure 2. Chemical state analysis via deconvoluted XPS N-1s spectra for PEALD- SiN_x on Si wafer with (a) low WER and (b) high WER. The insets highlight the I-3d peaks, revealing a direct correlation between precursor ligand entrapment and the degradation of film properties.

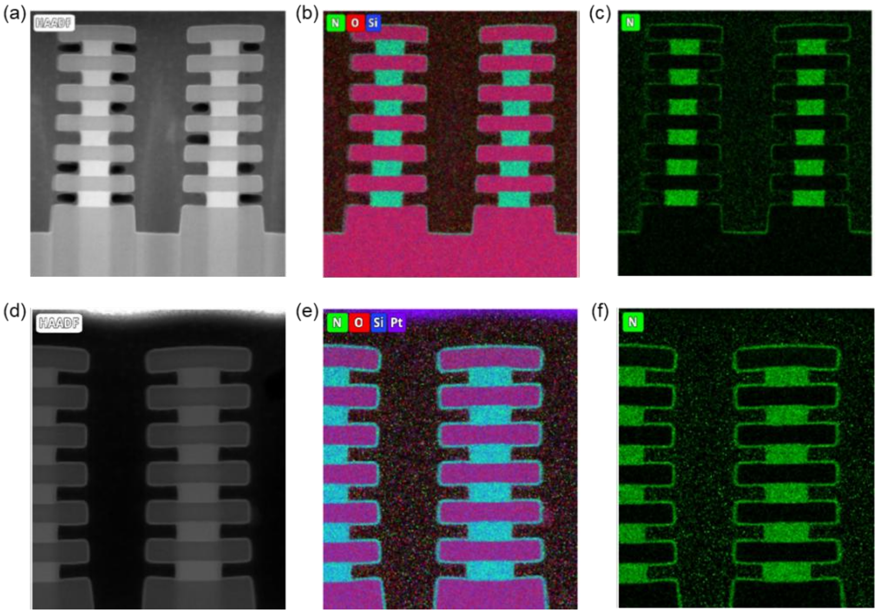

Figure 3. Cross-sectional TEM and EDX mapping of PEALD- SiN_x within high-aspect-ratio (HAR) 3D structures deposited at (a-c) 22.5 Torr and (d-f) 4 Torr. Transitioning to a low-pressure regime significantly enhances the molecular mean free path (λ), improving precursor diffusion and increasing the lateral step coverage within the bottom pockets to ~94%.

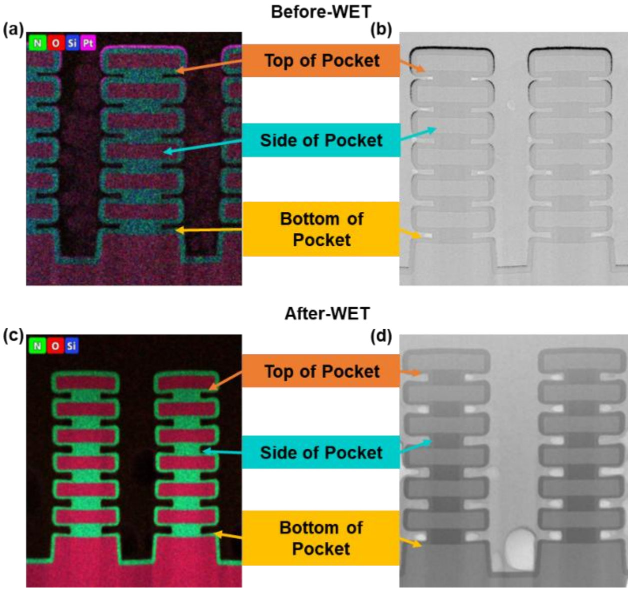

Figure 4. TEM and EDX characterization of 3D-integrated SiN_x spacers (a) before and (b) after a 30:1 HF wet etch process. The optimized deposition process yields a significant enhancement in chemical robustness at critical structural locations, where the WER at the lateral sidewalls (the traditionally "weakest" points) is reduced by approximately one order of magnitude.

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