# AFM-based chitosan nanopatterning using Pulse-Atomic Force Lithography technique

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Chitosan physical properties combined to its biocompatibility, make it a unique and environmentally-friendly resource for developing advanced materials for future technologies. In our research, we explored the potential of using chitosan films as substrates for Atomic Force Microscopy (AFM)-based lithography. We began by optimizing the fabrication protocol for spin-coating high molecular weight chitosan on silicon wafers functionalized with a silane. At first, we optimized the spin-coating high molecular weight chitosan on silicon wafers functionalized with a silane. Subsequently, we demonstrated the efficacy of the Pulse-Atomic Force Lithography (P-AFL) technique by successfully nanopatterning the chitosan substrates using NTEGRA AFM instrument equipped with an NSG30 tip.
P-AFL is a robust AFM-based mechanical lithography method that is easy to implement and offers nanometric precision in fabricating nanostructures. Specifically, we patterned sets of constant depth (Constant Pulse-AFL) and varying depth (Gradient Pulse-AFL) nanogrooves on a 100 nm chitosan film with high precision and reproducibility. In this framework, we successfully patterned nanochannels of 1 μm in length, with depths ranging from about 2 nm to 20 nm and corresponding widths from about 47 nm to 109 nm. Moreover, we demonstrated the capability to modulate the applied normal force during the lithography process to obtain varying depth nanogrooves characterized by a smooth depth profile.
P-AFL on chitosan presents a compelling alternative to conventional lithography techniques, offering unprecedented details with a sustainable manufacturing process. These findings hold significant implications for the semiconductor industry, which is increasingly focused on environmentally-friendly manufacturing and sustainable processing methods.

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