High aspect ratio titanium nitride trench structures as plasmonic biosensor

High aspect ratio titanium nitride (TiN) grating structures are fabricated by the combination of deep reactive ion etching (DRIE) and atomic layer deposition (ALD) techniques. TiN is deposited at 500 °C on a silicon trench template. Silicon between vertical TiN layers is selectively etched to fabricate the high aspect ratio TiN trenches with the pitch of 400 nm and height of around 2.7 µm. Dielectric functions of TiN films with different thicknesses of 18 - 105 nm and post-annealing temperatures of 700 - 900 °C are characterized by an ellipsometer. We found that the highest annealing temperature of 900 °C gives the most pronounced plasmonic behavior with the highest plasma frequency, ωp = 2.53 eV (λp = 490 nm). Such high aspect ratio trench structures function as a plasmonic grating sensor that supports the Rayleigh-Woods anomalies (RWAs), enabling the measurement of changes in the refractive index of the ambient medium in the wavelength range of 600 - 900 nm. We achieved the bulk refractive index sensitivity (BRIS) of approximately 430 nm/RIU relevant to biosensing liquids.

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