Antireflection Substrates for Determining the Number of Layers of Few-Layer Hexagonal Boron Nitride Films and for Visualizing Organic Monolayers

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Antireflection Substrate for Determining the Number of Layers of Few-Layer Hexagonal Boron Nitride Films and for Visualizing Organic Monolayers.

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Note S1: Locus of a non-absorbing layer

The locus of a non-absorbing layer in the multilayer coating is a circular arc in the circle diagram. The arc is traced clockwise and increases with layer thickness. The half-wave layer traces out a complete circle. If a q-th non-absorbing layer is deposited on a ($q-1$)-th layer, the size and position of the circle depend on the N_q and starting point of the arc, which corresponds to the termination of the locus of the previous layer, that is $\rho_{q-1}(d_{q-1}) = \rho_q(0)$. The locus of the $\rho_q(d)$ is given by

$$\rho_q(d) = \frac{\rho_q^T + \rho' exp(-2i\delta_q)}{1+\rho_1^T \rho' exp(-2i\delta_q)},$$

where, $\delta_q = 2\pi N_q d/\lambda$, $\rho_q^T = (N_m - N_q)/(N_m + N_q)$, $\rho' = (\rho_{q-1}(d_{q-1}) - \rho_q^T)/(1 - \rho_{q-1}(d_{q-1})\ \rho_q^T)$, respectively.[16] The center and radius of the arc are

$$\left(\frac{\rho_q^T\left(1-|\rho'|^2\right)}{1-|\rho'|^2 \rho_q^{T^2}}, 0\right)$$

and

$$\frac{|\rho'|\left(1-\rho_q^{T^2}\right)}{1-|\rho'|^2 \rho_q^{T^2}},$$

respectively. The center of the arc is on the real axis. In **Sec. 4.4**, the non-absorbing single layer on a metric base substrate is discussed for designing an AR coating with a layer of arbitrary materials on top, where it is important to consider the locus of the non-absorbing layer. In this case, $\rho_{q-1}(d_{q-1})$ is ρ_{sub}. **Figure S2** shows the loci of various non-absorbing layers with different refractive indices on the metric base substrate, indicating that the termination of the locus of a non-absorbing layer can be freely controlled in a wide range by adjusting the thickness and selecting the R of the base substrate.

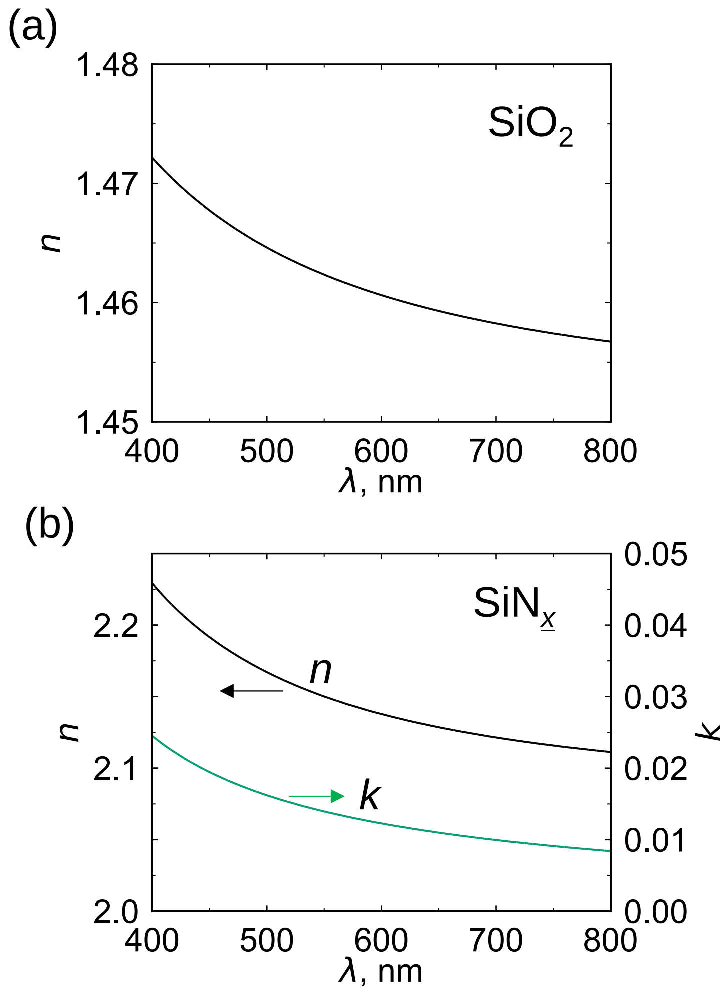

Figure S1: The refractive index of SiO_2 **(a)** and SiN_x **(b)** measured by the ellipsometer, respectively. The refractive index was obtained from dielectric dispersion with the Lorentz oscillator model.

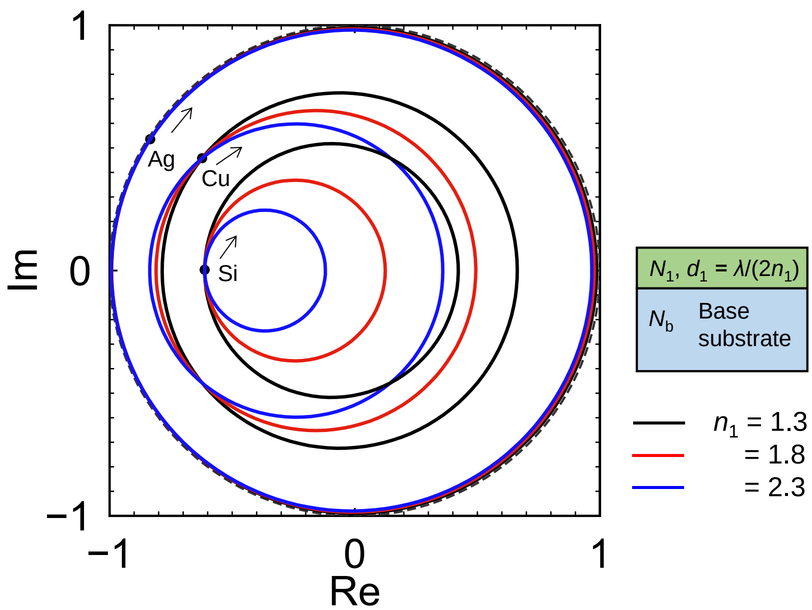

Figure S2: Loci of various non-absorbing layers with different refractive indices on the metric base substrate.

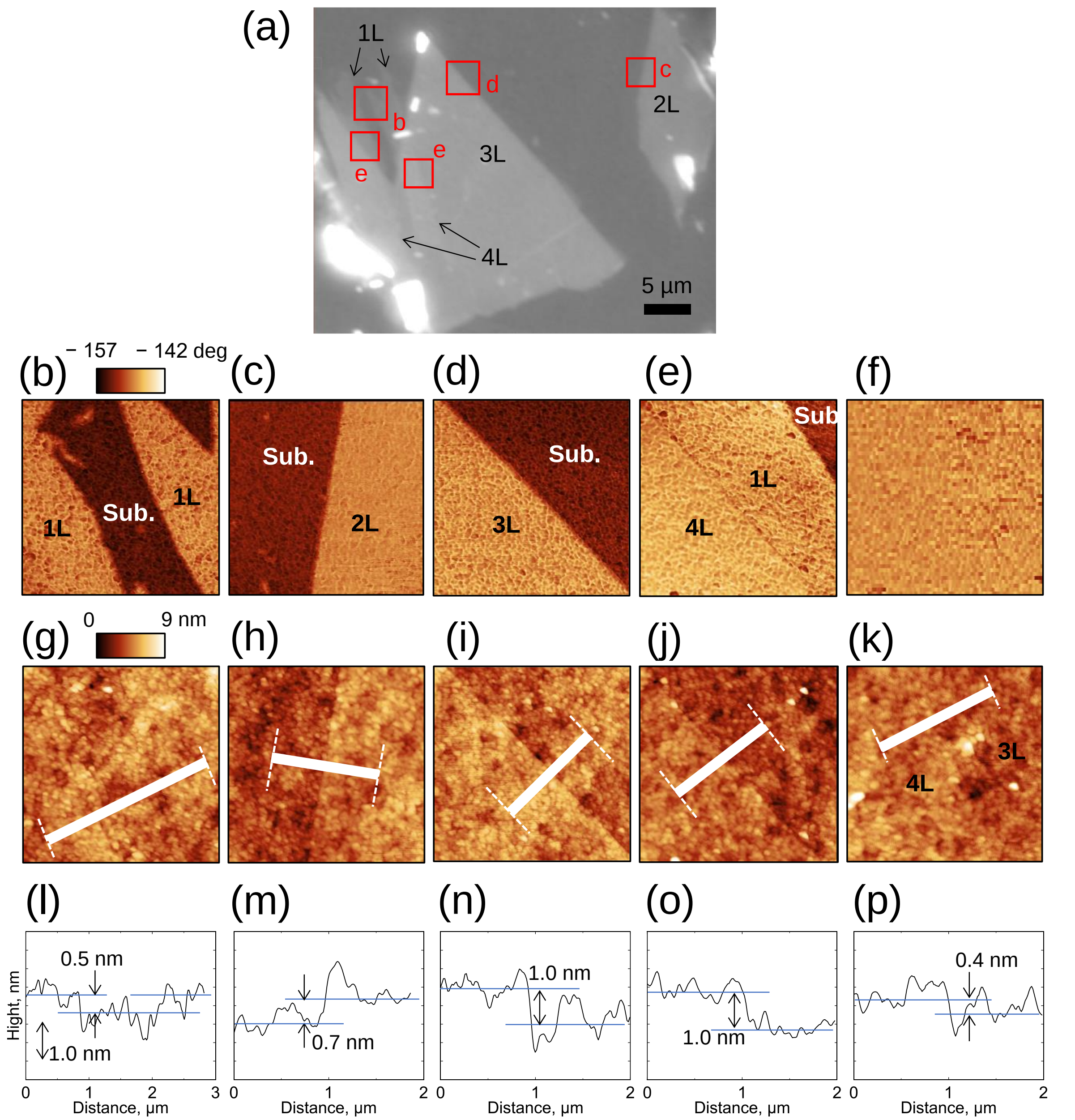

Figure S3: **(a)** Monochromatic image for 1−4 L hBN on the AR substrate at λ = 530 nm. **(b−f)** Tapping-AFM phase images corresponding to the red square in **(a)**. **(g−k)** Height images corresponding to **(b−f)**. **(l−p)** Profiles of the average height along the white solid bold lines in **(g−k)**.

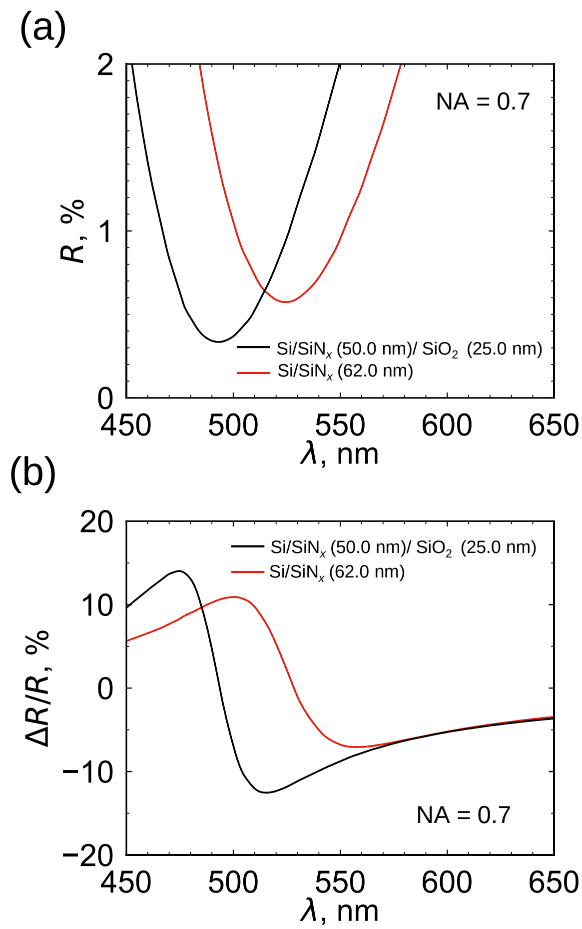

Figure S4: Calculated **(a)** reflection and **(b)** contrast spectra of AR substrates for NA = 0.7. The black and red lines indicate the Si/SiN$_x$ (62.0 nm) and Si/SiN$_x$ (50.0 nm)/ SiO_2 (25.0 nm) substrates, respectively. The contrast spectra is for 1L hBN on the AR substrate.