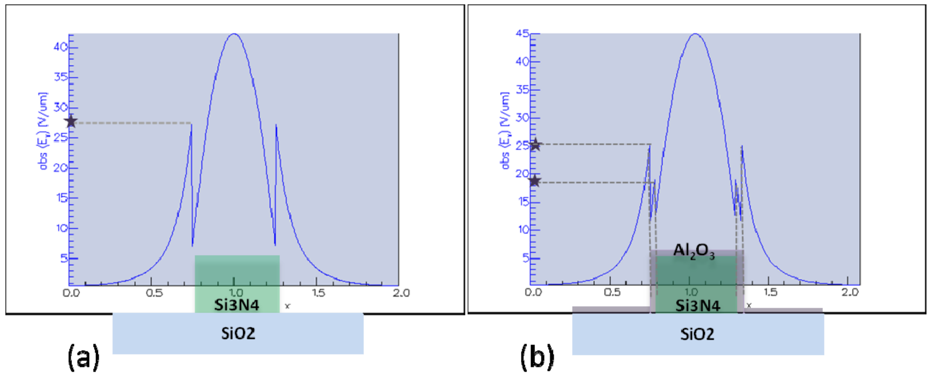

Fig. 6. E_x field distribution of the quasi-TE mode at the center of the Si_3N_4 strip waveguide are shown. On the Y-axis the E_x field amplitude are marked at critical material interfaces (a) Air clad Si_3N_4 wire showing a high E_x field amplitude at the rough, Si_3N_4-air material interface. (b) Al_2O_3 clad Si_3N_4 wire showing a lower E_x field amplitude at the rough, Si_3N_4-air material interface and a higher E_x field amplitude at the less rough Al_2O_3-air interface.

With ALD deposition, the optical mode fill-factor within the Si_3N_4 wire increases to 0.58 from 0.49 with air cladding (simulation results in Table 4). The increased optical mode confinement reduces the impact of surface roughness on the optical mode loss in the case of ALD clad waveguide.

Table 4. Comparison of fill factors in air clad and ALD coated Si_3N_4 chips.

ALD Clad Si_3N_4 Chip	Air Clad Si_3N_4 Chip
$n_{eff\,[TE]}$ = 1.6054	$n_{eff\,[TE]}$ = 1.5654
Fill $Factor_{Si3N4}$ = 0.5805	Fill $Factor_{Si3N4}$ = 0.4933

While this paper shows results on reduction from extremely high to moderately low propagation loss waveguides, the technique can also be used to reduce scattering losses from moderately low to very low propagation loss Si_3N_4 waveguides.

5. Conclusion

We demonstrate the impact of ALD-assisted conformal Al_2O_3 coating as a simple post-processing method in reducing the scattering loss in the PECVD Si_3N_4 wires (220 nm x 500 nm) at VNIR wavelengths. The RMS roughness of the nitride waveguides is reduced from 1.47 nm to 0.5 nm through this ALD coating. As a result, the waveguide loss is reduced from very high values, estimated to be ~60 dB/cm, to a moderate 5 dB/cm level at 900 nm wavelength. Both the RMS roughness and waveguide loss achieved after ALD coating is comparable to the values reported before on similar PECVD nitride waveguides at the same wavelength.

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