# Loss study of SiN Waveguides and Grating Couplers for Graphene Photonic Devices: Influence of CVD Conditions and Refractive Index Variations

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## Abstract

Silicon nitride is material compatible with CMOS (complementary metal-oxide-semiconductor) technology and have several advantages over the silicon as a waveguide material for graphene photonic devices. Silicon nitride has a large bandgap of 5.0 eV in comparison with 1.14 eV for silicon and a wide transparent optical window in the range of 0.25 – 8.0 µm [1, 2] meaning that silicon nitride has low absorption enabling to achieve lower loss waveguide in a wide wavelength range.

In this study, four different types of SiN layers have been grown and tested for the waveguide and grating coupler applications in graphene-based electro-absorption modulators, operating at O-band wavelength (Fig. 1a). SiN layers were deposited by plasma-enhanced chemical vapor deposition (PE-CVD) method, which enables the variations of the refractive indices of the grown layers by the variation of process conditions. The 400nm thick SiN waveguide deposited at lowest deposition rate of 3,6 nm/s exhibited 0,85 dB/cm waveguide loss and 4,8 dB loss per grating coupler (total loss 10,45 dB) (Fig. 1b) with a corresponding refractive index of 1,92 at 1290 nm wavelength. The FEM simulations showed the conformal light transmision through the WG (Fig. 1c) and coupling coupling loss of 4,4 dB. The full loss dependence as well as FEM simulations of the refractive index of the deposited SiN layers will be presented.

## References

[1] Ikeda, K.; et.al Opt. Express, 216 (2008) 12987.
[2] Su, Y.; et.al Adv. Mater. Technol. 5 (2020) 1901153.

## Figures

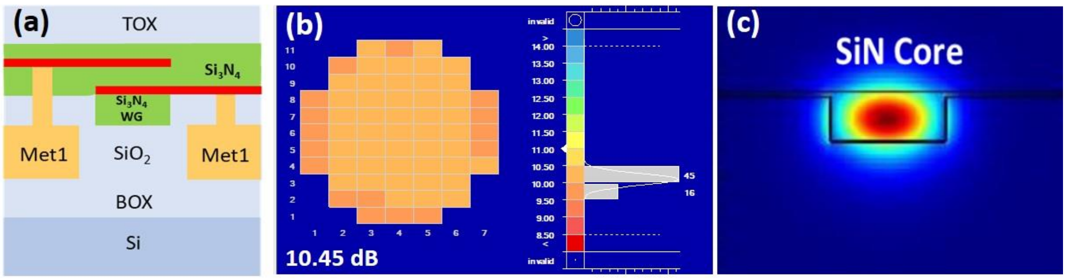


**Figure 1: (a)** cross-section schematics of dual graphene modulator. **(b)** total insertion loss distribution over 200 nm wafer processed in CMOS pilot line. **(c)** computational simulation results, showing conformal light transmission through 400 nm thick SiN waveguide.

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