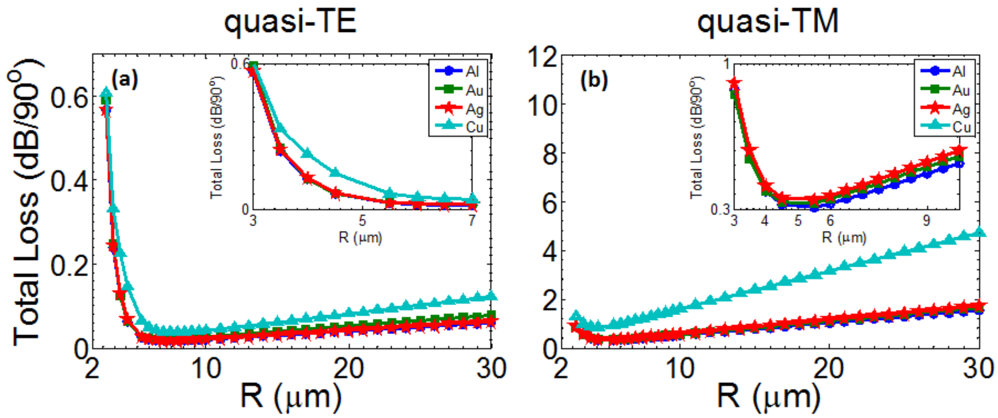

Fig. 7. Effect of metal type: Total loss (dB/90°) versus bend radius (R) for the metallic structure with the structural parameters of w_{ridge} = 2 μm, h_{ridge} = 2 μm, t_{metal} = 100 nm, t_{buffer} = 100 nm for different metals; Au, Ag, Al, Cu for (a) quasi-TE and (b) quasi-TM modes. The insets magnify the regions of small radii R.

5. Conclusions

In this work, we proposed and demonstrated numerically that introducing a thin metal layer underneath the core of a polymer waveguide permits the realization of sharp bends with calculated total losses (dB/90°) smaller than those of the equivalent dielectric waveguide without the metallic layer, both for quasi-TE and quasi-TM modes. The FD mode calculations indicate more than a 10-fold reduction of the bend losses with respect to the entirely dielectric structure for radii below ~35 μm for quasi-TE modes, for which total losses as low as 0.02 dB/90° have been calculated for a wide range of radii, which can be tuned by properly selecting the thickness of the buffer layer. A more modest decrease of the total losses has been obtained for the quasi-TM modes for radii between 3 and 10 μm. By choosing the right structural parameters, the introduction of the thin metallic layer permits to decrease the optimum bend radius from ~70 μm (i.e., in the entirely dielectric structure) to less than 10 μm while maintaining the total bend loss performance at ~0.02 dB/90°.

In TE polarization, the reduction of the total bend losses can be attributed to the shielding of the mode by the metal layer, which prevents it from leaking into the substrate. The mechanism for the reduction of bend losses is different in TM polarization, for which the higher confinement of the hybrid plasmonic-photonic mode to the metal layer permits decreasing the radius of curvature before coupling to radiation modes occurs.

The approach considered in this paper is quite promising, as it allows the use of polymer waveguides in large-scale photonic integration where sharply bent waveguides with radii of a few micrometers are essential to shrink the footprint of photonic circuitry.

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